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THE CANADIAN ASSOCIATION OF GEOGRAPHERS

THE CANADIAN GEOGRAPHER

LE GÉOGRAPHE CANADIEN

L'ASSOCIATION CANADIENNE DES GÉOGRAPHES

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THE CANADIAN GEOGRAPHER LE GÉOGRAPHE CANADIEN

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LE CAMIONNAGE AU CANADA EN 1957*

PIERRE CAMU
Université Laval

RÉSUMÉ. *Le Bureau fédéral de la statistique a publié en 1959 et pour la première fois, des chiffres fort intéressants sur le trafic du camionnage au Canada en 1957. Les données sont tracées sur des échantillonnages recueillis dans chaque province du pays. Nous avons exploité sommairement ces données en montrant les caractéristiques et l'importance de ce mode de transport dans les grandes régions économiques du pays. Enfin nous avons montré dans un graphique, les échanges de marchandises qui se font entre provinces par camion loué en service interurbain.*

ABSTRACT. *The Dominion Bureau of Statistics published for the first time in 1959, a new set of statistical data about the Truck transport industry in Canada. Based on samplings taken in every Province during the year 1957, it is now possible to compile some data on a geographical basis of the operations of "for hire" trucks and of the tonnages of commodities carried by truck and classified by category. Figure 1 illustrates the traffic of commodities carried by truck between major economic Canadian regions and between these regions and the U.S.A.*

Pour l'année 1957, et c'est la première fois qu'on le fait, le Bureau fédéral de la Statistique a publié une série de rapports sur le transport routier au Canada qui a suscité un vif intérêt[1]. Nous avons examiné ces rapports et voici quels sont les résultats qui ont une portée géographique et économique.

MÉTHODE DE RECHERCHES[2]

Les relevés statistiques sont basés sur des échantillonnages variant de 10 à 15% du nombre total de camions en opération dans chaque province. Les échantillons sont à leur tour basés sur des questionnaires envoyés aux compagnies de camions et aux camionneurs. Il s'agit de camions commerciaux seulement. On a exclu les camions militaires, les camions dépanneurs, les chasse-neige, etc. De plus, on a adressé les questionnaires à quatre moments, un par saison, et tous les questionnaires portaient sur une semaine d'opérations (7 jours). Environ 75% des questionnaires envoyés (100,846) furent retournés.

On a donc extrapolé les résultats, obtenant une image encore bien imparfaite de ce mode de transport au Canada. A cause de l'immatriculation différente des camions d'une province à l'autre et des relevés que l'on y prend, il y a du double-emploi et beaucoup d'approximations.

On a classifié les camions en quatre catégories que l'on désigne en français et en anglais comme ceci :

a) Camions de louage travaillant pour le compte d'autrui .... *For hire trucks*
b) Camions travaillant pour leur propre compte, service interurbain ..... *Private-intercity*
c) Camions travaillant pour leur propre compte, service urbain .. *Private-urban*
d) Camions travaillant pour leur propre compte, service de ferme *Private-farm*

La première catégorie "comprend les véhicules exploités à titre lucratif dans une province et munis d'un permis provincial", la deuxième catégorie comprend "les véhicules appartenant à une entreprise commerciale ou industrielle ou à un particulier et servant à transporter d'une ville à l'autre les matières premières, produits finis ou marchandises de l'entreprise". Les deux dernières catégories ne demandent pas d'explication.

Excluant les camions non-commerciaux du grand total de 1,109,550 véhicules, on obtient un chiffre de 832,055 camions. De ce nombre, 46,344 ou 5.6 pour cent sont des camions de louage (catégorie a); 214,992 ou 25.8 pour cent sont des camions privés affectés au service interurbain; 278,891 ou 33.5 pour cent sont des camions privés confinés aux districts urbains; et 291,828 ou 35.1 pour cent sont des camions utilisés par des fermiers canadiens.

Les données statistiques que nous avons choisi de commenter sont groupées dans les tableaux suivants en cinq grandes régions: Provinces Atlantiques, Québec, Ontario, Provinces des Prairies et Colombie-Britannique. Le premier tableau consiste en données de base, le deuxième nous renseigne

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* Communication présentée à la neuvième réunion de l'Association Canadienne des Géographes, Saskatoon, 1959.

sur les opérations de camions de louage et le troisième sur le trafic des marchandises transportées. Enfin, nous avons illustré par un graphique le mouvement des marchandises et cargaisons transportées par camion entre les régions et entre le Canada et les Etats-Unis.

LES DONNÉES DE BASE

La population du Canada a augmenté de 5,100,000 habitants entre 1941 et 1956, date du dernier recensement. Au cours de la même période, le nombre des véhicules commerciaux au Canada passait de 278,771 à 1,109,550, une augmentation de 830,779 camions.

Alors qu'on comptait un camion par 41.2 habitants en 1941, on compte maintenant 1 camion par 14 habitants (1957). C'est une augmentation formidable de ce moyen de transport. Nous avons cru nécessaire de commencer par cette comparaison afin de donner aux résultats détaillés qui suivent tout le relief qu'ils méritent. Car nous ne pouvons pas comparer avec les résultats de 1941, ils n'existent pas. En général cette première comparaison nous permet de dire que le camionnage par rapport à la population canadienne est trois fois ce qu'il était. Il y a trois fois plus de camions, et nous pourrions ajouter qu'il se transporte trois fois plus de marchandises, qu'on atteint trois fois plus de clients, bref que son rôle a triplé.

ROUTES, CAMIONS ET POPULATION AU CANADA EN 1959

Nous avons groupé dans le premier tableau trois séries de chiffres se rapportant à des choses différentes.

On a comparé les réseaux routiers entre eux et nous ne sommes pas surpris de constater que la région des Prairies a le plus grand réseau, Québec étant au troisième rang sur cinq; les rangs demeurent les mêmes si l'on compare le réseau de routes de première classe; 15 pour cent du réseau routier de première classe s'étend dans le Québec.

Nous avons ensuite séparé le nombre de camions en usage afin de dégager ce qui est commercial de ce qui ne l'est pas. Les Prairies canadiennes ont le plus grand nombre de camions suivi de l'Ontario, du Québec, de la Colombie-Britannique et des Provinces Atlantiques. Du nombre total, nous avons exclu les camions qui ne transportent pas. L'Ontario passe alors au premier rang avec 31.8% du nombre total de cette catégorie au Canada; Québec possède de 17.5% des camions qui transportent. Enfin, si l'on compare le nombre de camions de louage qui transportent pour d'autres, on constate que les provinces centrales ont le plus grand nombre.

Plus intéressant que la lecture brute de chiffres, les deux dernières lignes de ce premier tableau replacent, dans leur ordre de grandeur, les provinces et régions économiques majeures du pays; en effet, il s'agit de rapports entre deux choses. Le premier rapport est celui du nombre d'habitants par camion. Il y a un camion pour 7.2 habitants dans les Prairies, il y en a 1 pour 14.4 au Canada, et 1 pour 26.2 dans le Québec. C'est dans le Québec, qu'il y a, par rapport à la population, le moins de camions (comprenant toutes les catégories de camions). Si l'on compare le nombre d'habitants par camion de louage (for hire), on constate qu'il y a 1 camion par 250.8 habitants dans les Prairies, 1 camion par 340.9 personnes au Canada et 1 camion par 383.1 personnes dans le Québec. En Ontario, il y a 1 camion par 391.5 personnes. C'est dans les Provinces Atlantiques qu'on trouve le plus grand nombre de personnes par camion de louage, soit 404.3.

Il est entendu que si l'on divisait la région "Prairies" en ses trois provinces, Québec serait plus souvent en deuxième position après l'Ontario. Mais on pense de plus en plus en termes de grands ensembles. Si l'on divisait les Provinces Atlantiques en quatre unités, on aurait des résultats encore plus faibles. Cette nouvelle présentation est plus réaliste et voilà pourquoi, à notre avis elle est plus intéressante. N'oubliez pas cependant, que nous avons comparé camions et personnes avec une année d'intervalle, 1956 étant le dernier recensement officiel du Canada.

OPÉRATION DE CAMIONS DE LOUAGE

Les données statistiques de ce tableau se rapportent aux opérations mêmes. Elles

TABLEAU I — TABLE I
Routes, camions et population au Canada en 1957
Roads, trucks and population in Canada in 1957

| Nombre total | Nombre total | Nombre total | Nombre de camions | Nombre de | Population | Nombre | Nombre |

TABLEAU I — TABLE I

Routes, camions et population au Canada en 1957[1]
Roads, trucks and population in Canada in 1957[1]

	Nombre total de milles de route en 1956 Total road mileage in 1956.	Nombre total de milles de routes de première classe en 1956. Total first class road mileage in 1956.	Nombre total de camions en 1957. Total number of trucks in 1957.	Nombre de camions excluant ceux qui ne transportent pas. Number of trucks that do not perform transportation services.	Nombre de camions travaillant pour le compte d'autrui. Number of for hire trucks.	Population en 1956. Population in 1956.	Nombre d'habitants par camion. Number of inhabitants per truck.	Nombre d'habitants par camion loué. Number of inhabitants per For hire truck —
Prov. Atlantiques	39,625	27,356	79,145	66,698	4,362	1,763,692	22.2	404.3
Québec	43,720	32,088	176,281	147,075	12,081	4,628,378	26.2	383.1
Ontario	75,657	65,723	345,961	265,185	13,803	5,404,933	15.6	391.5
Prairies	268,628	67,594	393,778	264,813	11,375	2,853,821	7.2	250.8
C.-B.	23,865	13,874	112,092	88,284	4,723	1,398,464	12.4	296.0
Canada*	453,582	209,328	1,109,550	932,055	46,344	16,080,791	14.4	346.9

TABLEAU II — TABLE II

Opérations de camions de louage, travaillant pour le compte d'autrui en 1957 au Canada[1]
Operations of for hire trucks in Canada in 1957[1]

	Nombre de milles (moyenne annuelle) parcourus par camion. Average yearly mileage per truck.	Poids des marchandises transportées: tonnage total en milliers de tonnes. Weight of goods carried: total tons of goods carried.	Poids des marchandises transportées: tonnage moyen transporté par camion et exprimé en tonnes. Weight of goods carried: average weight carried per trucks in tons.	Tonnage total net exprimé en milliers de tonne-mille. Total net ton miles performed.	Tonnage net moyen transporté par camion et exprimé en tonne-mille. Average net ton miles per truck.	Revenu par tonne-mille en cents. Revenue per ton mile in cents.	Revenu moyen par camion en $. Average revenue per truck in $.
Prov. Atlantiques	13,400	11,081	5.5	198,721	45,600	9.7	4,400
Québec	21,500	29,350	8.4	1,686,934	139,600	8.0	11,200
Ontario	25,600	44,843	10.1	2,547,166	184,500	6.8	12,600
Prairies	31,900	8,422	8.6	818,217	189,666	6.6	12,800
C.-B.	19,600	17,252	9.5	594,118	125,800	9.1	11,400
Canada*	22,400	110,948	8.4	5,956,104	137,033.2	8.0	10,480

* Le total inclut, en plus, les données statistiques pour le Yukon et les territoires du Nord-Ouest.
The data for Yukon and Northwest Territories are included in the total for Canada.

sont plus significatives que les précédentes. Car on peut avoir plus de camions, mais des plus petits, dans ce cas on transporte moins; si l'on veut transporter autant, il faut faire plus de voyages.

Il s'agit de statistiques des opérations de camions de louage, travaillant pour le compte d'autrui seulement, ceux définis comme faisant partie de la première catégorie du début (for hire). De plus, il s'agit de l'ensemble des opérations des camions de chaque province, incluant ce que ces camions ont transporté dans les autres provinces et les milles parcourus ailleurs que dans leur province respective.

Ce sont les camions des Prairies qui parcourent le plus grand nombre de milles en moyenne par année. La géographie de cette partie du Canada en est la cause: pays plat, pays sans limites. Les camions immatriculés au Québec parcourent 21,500 milles, moyenne qui se rapproche de la moyenne canadienne de 22,400 milles.

Ce sont les camions de la province d'Ontario qui ont transporté le plus fort tonnage de marchandises, soit 44.0 millions de tonnes, suivis de ceux du Québec de 29.4 millions de tonnes. On constate le même rang lorsqu'on examine le tonnage net exprimé en milliers de tonne-mille. Le tonnage net moyen exprimé en tonne-mille, par camion indique que le camion des Prairies transporte 189,666 tonnes-milles, celui de Québec transporte 139,000

TABLEAU III — TABLE III

Tonnages de types de marchandises transportées par camion (catégories a et b) en 1957 en milliers de tonnes.[3]

Tonnages of commodities carried by truck in 1957 in thousands of tons and classified by category.[3]

A— Trafic interprovincial et international seulement

A— Interprovincial and international traffic only

Produits-Products	Prov. Atlantiques	Québec	Ontario	Prairies	C.-B.	Canada
Agricoles-agricultural	26	156	179	52	53	466
Animaux-animal	15	84	180	144	44	473
Miniers-mining	9	57	9	2	24	101
Forestiers-forestry	108	477	104	45	90	824
Manuf. Mfg.	41	1,617	2,039	524	255	4,476
Divers-others	14	770	614	272	52	1,722
TOTAL	213	3,161	3,131	1,039	518	8,062

B— Trafic intraprovincial seulement

B— Intraprovincial traffic only

Produits-Products	Prov. Atlantiques	Québec	Ontario	Prairies	C.-B.	Canada
Agricoles-agricultural	388	1,390	3,840	943	469	7,030
Animaux-animal	600	2,363	3,493	1,129	475	8,060
Miniers-mining	17,519	29,554	35,453	16,218	9,988	108,732
Forestiers-forestry	5,460	6,295	3,047	842	5,402	21, 046
Manuf. Mfg.	3,314	13,599	22,201	8,360	3,271	50,745
Divers-others	926	2,927	3,357	2,240	1,114	10,564
TOTAL	28,207	56,128	71,391	29,732	20,719	206,177

tonnes-milles, ce qui est légèrement supérieur à la moyenne du camion canadien.

Le revenu par tonne-mille en cents nous indique que ce sont les camions des régions extrêmes, ceux des Provinces Atlantiques et de la Colombie-Britannique qui occasionnent les revenus les plus élevés soit 9.7 et 9.1 cents par tonne-mille. Dans le Québec c'est 8 cents, en Ontario 6.8 et dans les Prairies 6.6 cents de la tonne-mille. Par contre c'est dans les Prairies que le revenu moyen par camion était le plus élevé soit $12,800. Dans le Québec, le revenu était de $11,200 et dans les Provinces Atlantiques il s'élevait à $4,400 seulement.

TONNAGES DE TYPES DE MARCHANDISES

Que transporte-t-on ? Il y a deux réponses qu'on peut toujours donner : cela dépend des spécialités régionales, dans une région minière, on transportera surtout des produits miniers, mais dans une zone forestière, des produits de la forêt. La géographie économique commande cette première réponse. En deuxième lieu, on dira que les camions sont surtout des spécialistes de petites quantités, transportées de porte en porte et qu'ils transportent surtout des produits manufacturés et des paquets.

C'est ce que nous révèle le tableau III, dans la première moitié, au sujet du trafic par camion entre provinces et avec les Etats-Unis[3]. Plus de 50% des marchandises transportées au Canada, dans le Québec, en Colombie et dans les Prairies, sont des produits manufacturés. Dans les Provinces Atlantiques, on transporte plus de 50% de produits forestiers. Un détail intéressant à relever, les camions immatriculés au Québec transportent 38% du tonnage total canadien. Ils sont au premier rang.

La deuxième moitié du tableau est consacrée au trafic interne, qui se fait sans sortir de la Province. Partout, on transporte plus de produits miniers que toute autre chose: gravier, sable, pierre, charbon, pétrole suffisent à justifier cette prépondérance. Les produits manufacturés arrivent au deuxième rang dans le Québec, l'Ontario et les Prairies. Il y a rapport direct entre la population et le volume des produits transportés. C'est dans les provinces les plus peuplées qu'on a le plus gros trafic de marchandises transportées par camion.

Nous avons additionné les deux totaux du tableau III, et le tableau IV montre, pour chaque province ou région, le tonnage total de marchandises transportées par camion en milliers de tonnes.

En combinant les marchandises transportées par les camions (catégories a et b du début) qui sillonnent les routes canadiennes, on obtient un graphique qui illustre le trafic-marchandises d'une province à l'autre et entre les provinces et les Etats-Unis.

Plus de 4,800,000 tonnes de marchandises ont été transportées entre le Québec

TABLEAU IV — TABLE IV

Tonnage total de marchandises transportées par camion en 1957 en milliers de tonnes

Total tonnage of merchandises transported by truck in 1957 in thousands of tons

	Prov. Atlantiques	Québec	Ontario	Prairies	C.-B.	Canada
Trafic interprovincial et international	213	3,161	3,131	1,039	518	8,062
Trafic intraprovincial	28,207	56,128	71,391	29,732	20,719	206,177
TOTAL	28,420	59,289	74,522	30,771	21,237	214,239
% du total	13.2	27.9	34.7	14.3	9.9	100

et l'Ontario, près d'un demi-million entre l'Ontario et les provinces des Prairies. On n'est pas surpris de constater que le trafic par camion entre les Etats-Unis et le Canada s'élève à plus de 1,412,000 tonnes, soit 633,000 tonnes importées et 779,000 exportées vers les Etats-Unis. Le commerce international le plus volumineux avec les Etats-Unis est fait avec l'Ontario, soit plus de 542,000 tonnes; les camions partant de points du Québec ou arrivant des Etats-Unis dans des centres du Québec ont transporté 418,000 tonnes en 1957.

Tous ces tonnages sont faibles, ils ne reflètent qu'une partie du trafic, car les tonnages transportés dans des remorques échangées aux frontières provinciales, ne sont pas inclus. La carte-graphique vaut ce qu'elle vaut. C'est un essai.

CAMIONS DE VILLE ET DE FERME

Les camions immatriculés dans les districts urbains (catégorie c) franchissent une distance moyenne annuelle de 6,200 milles. Plus de 40 pour cent sont immatriculés en Ontario. La charge moyenne transportée pèse 1.4 tonne, ce sont des camions qui reviennent souvent vides, ils servent surtout à la livraison.

La majorité des camions de ferme sont immatriculés dans les provinces des Prairies. Au Manitoba, 55.9 pour cent de tous les camions de la province, sont des camions utilisés sur les fermes, en Alberta, le pourcentage est de 56.6. La plus forte concentration est en Saskatchewan avec un pourcentage de 78 pour cent.

CONCLUSION

Nous n'avons pas épuisé la source. On pourrait répéter cette analyse par classe de camions, par exemple, les camions de 0.5 tonne, 5-75, 7.5-10, -10 -15, 15-25 et 25 tonnes et plus. Là où nous aimerions posséder plus de renseignements c'est au sujet du trafic par groupe de denrées et les échanges que l'on fait entre provinces.

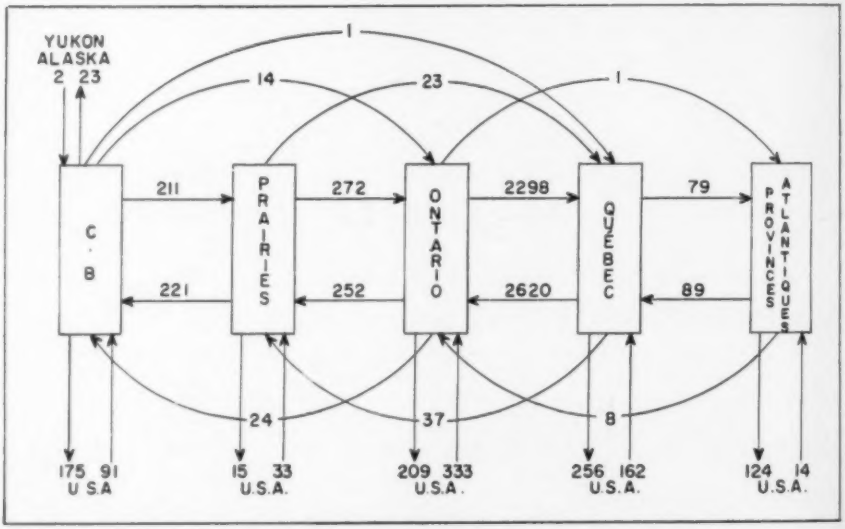

FIGURE 1. Trafic de marchandises transportées par camion entre Province canadiennes et avec les Etats-Unis en milliers de tonnes en 1957.

FIGURE 1. Traffic of commodities carried by truck between Canadian Provinces and the United States in thousands tons in 1957.

RÉFÉRENCES

1. *Motor Transport Traffic Statistics,*

		Dominion Bureau of Statistics Ottawa,	1958
British Columbia,	1957.		
Alberta	"	—	—
Saskatchewan	"	—	—
Manitoba	"	—	—
Ontario	"	—	—
Quebec	"	—	—
Atlantic Provinces	"	—	—
National Estimates	"	—	1959

2. L'historique et la procédure de ce premier relevé sont expliqués dans les premières pages du rapport final. *Motor Transport Traffic Statistics National Estimates,* 1957, Ottawa, 1959.

3. Dans ce tableau, nous avons groupé les tonnages transportés par camion de louage (Catégorie a) et par camion travaillant pour leur propre compte, service interurbain (Catégorie b).

4. Basé sur *Motor Transport Traffic Statistics National Estimates,* 1957, page 12.

RIVER VALLEY CITY — EDMONTON ON THE NORTH SASKATCHEWAN *

WILLIAM C. WONDERS
University of Alberta

ABSTRACT. *The North Saskatchewan River and its Valley have played a dominant role at all times in the urban geography of Edmonton, Alberta. They have been both an asset and a liability. Locally the Valley varies from one-half to one mile in width and averages about 160 feet in depth, approaching 200 ft. in places. The great variations in seasonal flow of the river are most important in terms of water supply, waste disposal, and occasional flood risk. At one time the river was a major transportation route. Former mining activties in Edmonton (coal, gold, clay, gravel) have been influenced greatly by the river and its Valley, as has the survey system reflected in the present street layout of Edmonton. Finally, the Valley always has been a barrier to north-south movement in the city, but it also has become invaluable for recreation and park land purposes as the city grows.*

RESUMÉ. La rivière North Saskatchewan et sa vallée eurent une influence dominante sur la géographie urbaine de la ville d'Edmonton, Alberta. Leurs effets furent tour à tour avantageux et désavantageux. Dans cette région la vallée varie en largeur entre un demi-mille à un mille tandis que sa profondeur atteint en moyenne 160 pieds, bien qu'elle soit de 200 pieds dans certains secteurs. Les variations saisonnières du débit de ce cours d'eau sont d'une très grande importance si l'on y considère certains aspects tels que l'approvisionnement d'eau potable, l'écoulement des immondices et les risques occasionnels d'inondations. Cette rivière fut déjà une artère très achalandée. L'industrie minière d'autrefois à Edmonton (charbon, or, limon, gravier) très étroitement liée au cours d'eau et à sa vallée, tout comme le réseau d'arpentage, maintenant réfléchi dans le tracé urbain d'Edmonton. Ainsi, la vallée fut toujours une obstruction à la circulation nord-sud dans la ville, mais celle-ci y gagne par l'acquisition de terrains propices à la récréation, au fur et à mesure que la ville progresse.

All major plains cities in the Canadian West with the exception of Regina, are situated on rivers. This is no geographic accident. In a region of generally arid to semi-arid climatic conditions, water is an important and, at times, is *the* critical factor for man's occupancy. Particularly is this true for urban centres. In a region of generally level to gently undulating terrain, the river valleys provide a major element and at times provide the major element in local landscape variety. In this they are at once an asset and a liability for urban centres. The North Saskatchewan River and its valley have played at all times a dominant role in the life of Edmonton, Alberta.

At Edmonton the bedrock consists of sandstones and shales often poorly consolidated, which make up the Edmonton formation, the uppermost of the Cretaceous. These strata dip westward very gently. Glacial till mantles the site completely, however, in places well over one hundred feet thick and to an average thickness perhaps of about sixty feet.[1] Further modification was due to an extensive proglacial lake, the bed of which covered the present city area. The result was the production of a nearly flat upland at a general elevation in the city of 2160-2180 feet above sea level.

Cutting across the area from southwest to northeast, the North Saskatchewan River divides Edmonton so that roughly two-thirds of the urban area is on the north side. (Figure 1). The twisting, deep valley ranges in width from one-half to one mile locally. It averages about 160 feet in depth, but in places may approached 200 feet. Upper terrace levels are evident at several points and stream gravels have been noted underlying till in places, but comparatively little is known of the geomorphic history of the valley. It would appear that part of the present valley, at least, is preglacial but its relationship with a large drift-filled channel which has been established at points in the city site, remains to be established.[2]

Several tributary ravines enter the main valley from both sides. Originally these drained the adjacent slough-dotted upland surface, though some of those on the south side headed in the western margins of the pronounced moraine just east of the present city. The streams occupy-

* Presented at the Eighth Annual Meeting of the Canadian Association of Geographers, Edmonton, 1958.

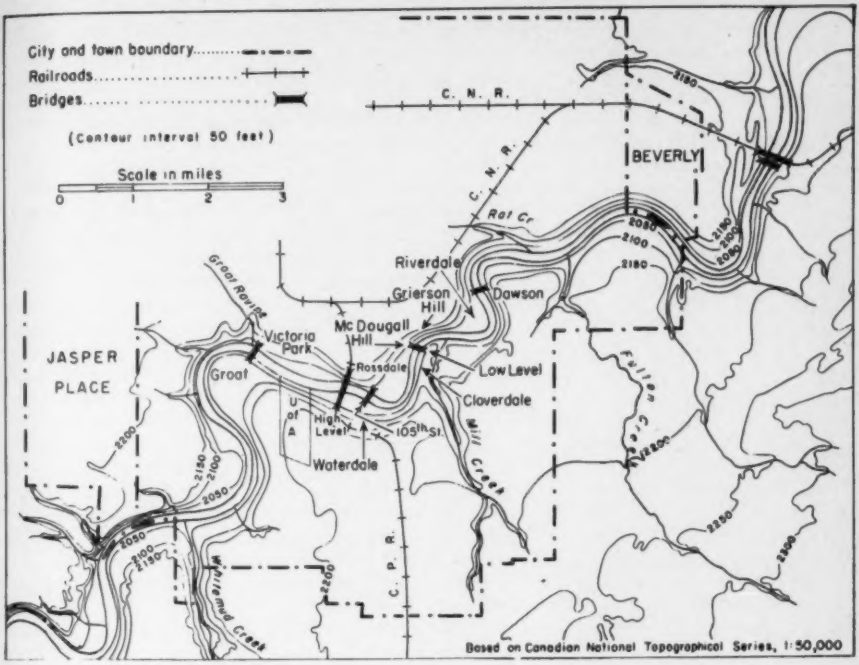

FIGURE 1

ing these ravines are purely seasonal today at least, with the exception of Whitemud Creek in the extreme southwest. Though the upper portions of several of these ravines have been filled in, they do direct the adjacent upland especially in their lower courses. Amongst the most important on the south side of the main valley are Fulton Creek, Mill Creek, and Whitemud Creek. The Groat Ravine and Rat Creek Ravine are most important on the north side.

On the floor of the valley the North Saskatchewan River meanders from side to side, with well developed undercut bluffs and slip-off slopes. Only in some of the former does bedrock outcrop on the local scene. Slumping of these undercut bluffs occurs from time to time. Through most of the city area the river is incised below the general level of valley bottom or "flats" about 20 to 30 feet. The stream bed is of mud and sand with frequent shallows or bars and occasional gravel lenses. During the summer the North Saskatchewan River flows at an average rate of seven to nine miles an hour[3] in Edmonton and carries an estimated daily load of approximately 13,125,000 pounds of silt.[4] It averages about 200 yards in width.

The most striking feature of the River is the great seasonal fluctuation in flow. A 33-year record[5] shows an average monthly range from a low of 1120 c.f.s. in February to a high of 20,510 c.f.s. in July. This represents a variation of over eight feet in river height, but in most years the maximum range is considerably greater still. The greatest extremes on record are a low of 220 c.f.s., (only 6.6 feet above gauge height on January 1, 1940), and a high of 204,500 c.f.s. when the water rose 45.0 feet on June 28, 1915.

From the time that the river freezes over (November 1-December 15, average

November 15) until spring break-up, there is little change in the depth of water in it.[6] At the city power plant there is usually eight or nine feet of water in the river bed. Below this point there is almost always open water now because of the discharge of warmed water, but ice does cover the entire river surface upstream. Average thickness at its maximum is from 20 to 30 inches, though 48 inches was reported in February, 1910.

Spring break-up usually occurs between April 11 and 16. (The earliest on record is April 4, 1930, and the latest is May 6 recorded in both 1909 and 1920.) The ice usually "goes out" in sectors, working its way back upstream. Break-up is due to two factors. Spring runoff water from the tributary creeks and the adjacent upland raises the river level and cracks the ice. Also as ice breaks away downstream it frequently jams at various points for short periods. This backs up the water appreciably and the additional rise in water level is sufficient to further crack the ice and allow it to move out.[7] After the local ice has cleared away, floe ice from upstream comes down in some quantities for a few days. Afterwards the level usually drops several feet with the disappearance of spring runoff water.

Gauging station records are available for a considerable time,[8] but there has been comparatively little work done on the vital and complex correlation of climatic, runoff, and river flow statistics. Understanding of the river behaviour consequently is still incomplete. Generally, however, the river flow begins to increase again in late May. Levels reach their highest point in late June, at which time they reflect the maximum combined effects of two sources of water: rainfall in the watershed, and melting snowfields and glaciers in the mountain headwaters. Thereafter the river begins to fall again towards its winter level. However, local sudden rises may occur in the river quite unexpectedly, as was the case in August of 1899 and 1954. A rise of 10 feet in 10 hours is possible. Though these are probably linked with unusually heavy rains, a complete explanation is not possible.

Microclimate produced significant local vegetation contrasts in the North Saskatchewan River Valley, as elsewhere in the plains. Especially noticeable is the variation between south-facing and north-facing slopes due to the shade or moisture factor. Originally the upland surface was marked by parkland vegetation. The south-facing valley slopes, however, were dominantly grass and shrub-covered, with such plants as the spear grasses, side oats grama grass, snowberry, sakatoon berry, and roses. The north-facing valley slopes were dominantly forested, by such trees as white spruce, balsam poplar, aspen poplar, some paper birch, and the red dogwood.

SETTLEMENT

The significance of this site factor in the urban geography of Edmonton has been very great. It obviously has been a divisive element. A valley of such proportions poses a serious barrier to easy north-south movement. To the first European inhabitants in their fur trading forts,[9] this was a considerable defensive asset. By building their forts on the north side of the River, it functioned as a natural moat against the more warlike Plains Indians, chiefly the Blackfeet, who traded along with the Crees, and the Mountain Stoneys.[10] Fort Edmonton of the Hudson's Bay Company was the nucleus from which settlement developed. Because of the great Valley the Calgary and Edmonton Railway (later part of the C.P.R.) never reached Edmonton proper, but remained on the south side of the river when it arrived in 1891. Around this terminus a second settlement nucleus formed which ultimately grew into the incorporated city of Strathcona.

Movement across the river was always possible unless it was in flood. Two fords existed, one just below the present High Level Bridge and another near the present Low Level Bridge. Ferries were introduced later. Yet the two communities remained separate, sharing the River Valley but divided by it. It was not until 1899 that the first bridge was built across the river (the "Low Level Bridge"), over

which Edmonton's first railway in 1902 linked the older north-side settlement with that on the south. The geographical separation resulting from the valley was intensified by local partisanship in the two centres. After the creation of the Province of Alberta in 1905, Edmonton was made the capital but Strathcona the university city. Significantly, the decisive factor in effecting amalgamation of the two cities in 1912 was the construction of the "High Level Bridge" and the extension of the C.P.R. across into Edmonton.

Present-day street patterns and legal subdivisions within the city reflect the influence of the River Valley. Through much of the city the usual grid pattern of the Western Canadian "township and range" survey predominates, even though it may be masked somewhat by the planned subdivisions of the past ten years. Settlement took place locally before the grid survey was extended to the area however. Following transfer of Rupert's Land from the Hudson's Bay Company to the Dominion of Canada in 1869, it was necessary to survey the Company's local reserved block of territory. This unit, surveyed in 1870, was centred on the fort. It extended east-west approximately one and a half miles and inland for over three miles north from the river. It then became possible for individuals to stake claims to the free land for the first time. The first were made immediately east of the "Hudson's Bay Reserve" (the present 101 Street was the east boundary of the Reserve), and the nine lots involved became the core of the Edmonton Settlement which was incorporated as a village in 1871. The holdings were typical "river lots", fronting on the North Saskatchewan and extending back in most cases to the Rat Creek Ravine. Unlike the Hudson's Bay Reserve boundaries, which were

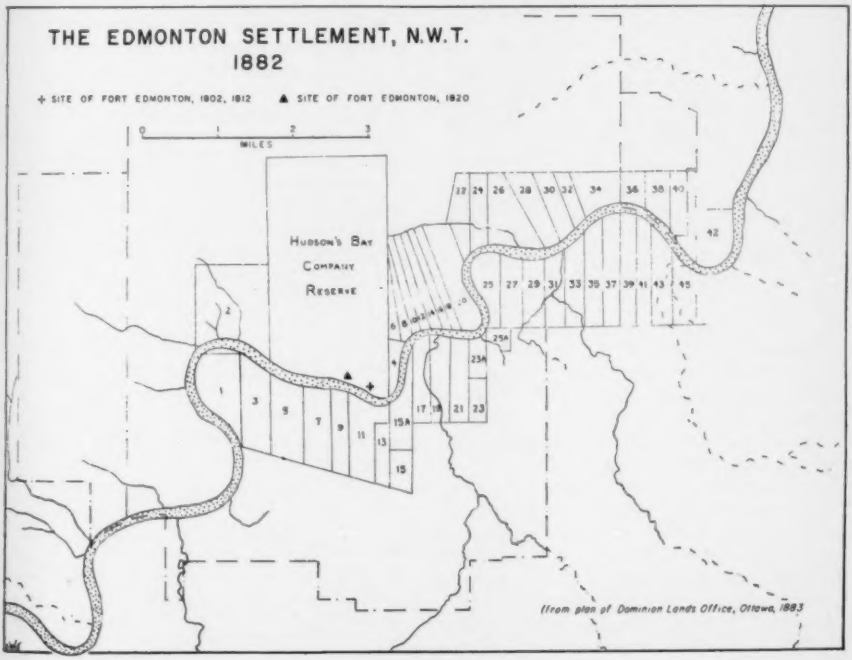
THE EDMONTON SETTLEMENT, N.W.T.
1882
+ SITE OF FORT EDMONTON, 1802, 1812
▲ SITE OF FORT EDMONTON, 1820
0 1 2 3
MILES
HUDSON'S BAY COMPANY RESERVE
(from plan of Dominion Lands Office, Ottawa, 1883)

FIGURE 2

based on north-south survey lines, the boundaries of the river lots angled north-west-southeast in order to adjust to the northward bend of the River Valley in that sector. These show up very strikingly in today's street layout.

Additional river lots were carved out on both sides of the North Saskatchewan as the settlement grew, until an 1882 survey numbered 45 of them. (Figure 2). Following that year the new system of "grid" homestead grants prevailed. Though the later river lots are not as striking in the present street pattern, they can still be traced. The north-west-southeast trending Univeristy Avenue on the South side of the city is especially noticeable and represents the rear property line which paralleled the river direction in this sector.

MINERALS

The North Saskatchewan River and its valley have played an important role in the mineral resources of Edmonton. Local bedrock is coal bearing and a fairly persistant coal horizon occurs, although it is rather variable in extent and thickness. The seam which outcrops just east of the city at Clover Bar is the most important, and the only one that can be relied upon over any extended area.

"The thickness of this seam, although as great as 8 feet at Clover Bar, does not average much over 5 feet for the district, and in local sections it decreases, for small area, to scarcely workable dimensions. Beneath, at a further depth of between 15 and 20 feet, there is... another seam... (which) runs from 4 to 7 feet in thickness."[11] The coal is of sub-bituminous or lignite quality.

First reported use of local coal was in 1863 by the fort blacksmith. Mines were opened locally before 1881. In 1882 six were operating on McDougall Hill near the present 100 St.[12] and in 1900 there were 22 mines working along the river.[13] Subsequently the operations within the city declined and new mines opened in the surrounding area. Coal mining remained an important economic activity in the vicinity until very recently.[14] 193 mines have been registered in the Edmonton area besides innumerable "gopher holes" which supplied those individuals

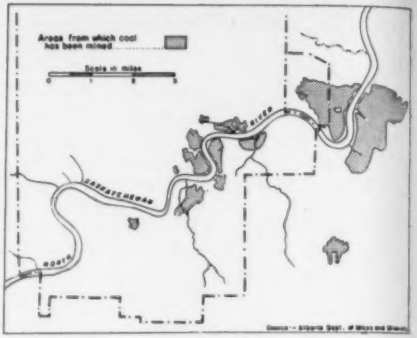

FIGURE 3. Edmonton — Coal mines.

who simply dug into the valley side for their own coal needs. (Figure 3)

The early mines in most cases were drift mines, working in from the valley face. As operations proceeded farther back from the valley, however, shaft mining methods were introduced. This also became necessary as coal was worked farther west. The coal seam outcropping about 10 feet above the river level on the eastern outskirts dipped westward at a rate of about 15-20 feet per mile.[15] Hence even those mines on the river flats to the west had to sink a shaft to reach the seam. Yet the valley was an important asset in the development of coal mining, especially in its earlier phases. It is noteworthy that the northern limits of the coal mines in Beverly on the city's eastern outskirts, seem to have been set by the old drift-filled river channel to which reference has been made earlier. In the course of its valley cutting, the former river occupying this channel removed the coal seams.

The North Saskatchewan River is gold bearing at Edmonton. Placer deposits were first recovered in 1863-4 from the gravel bars in the river by miners from the Cariboo fields. Since then they have been worked over from time to time, notably during the Klondike rush and during periods of economic depression.

"The gold bearing gravel varies from eight inches to four feet in depth, sometimes extending under the bank of the river. In such cases it sometimes pays to tunnel, or drift in, and bring out the dirt to be washed. This gives

winter employment, but generally at small wages. The summer season is short, as the richest places can only be got at in low water, and is generally only a month or two in the spring, before the June rise takes place, and again a month or two in the fall, after the water has lowered." Thus were the deposits described in 1881.[16]

Greatest year of gold production was in 1896 with 2661 ounces recovered,[17] but the yield dropped as the big wave of settlement started. Recovery was by means of the pan, "grizzly" or sluice box, and dredge (as many as 4 dredges operated in one season in and near the city up until about 1905). In 1932, 100 men were reported working the river gravels from Edmonton upstream but the average daily earning of one dollar was only enough to keep them off the breadline.[18] The latest attempt to revive gold-sluicing was in 1950 but proved unprofitable.

It is the gravel itself which has been of greater importance than gold to Edmonton, for road and building purposes. Gravel is not too abundant in the general area and the river deposits have been of great importance to the city. The bars of the present River have been dredged and some of the lower terraces have yielded gravel for the city's use. Unfortunately the gravel seems to occur chiefly in one stratum and accessible local supplies appear to have been completely exhausted.

One final mineral resource of Edmonton contribued by the North Saskatchewan River is brick clay. Approximately 14 to 16 feet of suitable clay covered by only a foot of overburden commonly occurs on the valley bottoms. This was utilized by local brick yard beginning in the early 1890's. At their peak, in 1911-13. there were nine brick yards in operation on the valley bottoms.[19]. Clay deposits on the flats at Victoria Park. Waterdale, Cloverdale, and Riverdale were the areas chiefly involved. A common red brick was produced which is evident still in many of the older buildings in the city. Though some local coal was used, cordwood cut from valley slopes and terraces was the chief fuel until natural gas came in for the remaining brick yards in the 1930's. Operations were seasonal since the brick was cured by the sun and wind. Production normally took place from about the first week in May until the third week in September. The last remaining brick yard ceased production in Riverdale in 1955. Even though clay was still available on the site, the building industry required a variety of types instead of just one. The company now imports all its bricks and functions only as a distributor from the old yards.

TRANSPORTATION

The repercussions of the River Valley on transportation have been great from the initial establishment of the original fort to the present. The River was the transportation medium as with other fur trade posts. Later, the situation advantages of Fort Edmonton with reference to the vast water routes to north and west emerged. Especially with the development of the long overland portage to Fort Assiniboine on the Athabasca, Fort Edmonton became the most important post between Norway House and the Pacific coast, handling all northern cross-continental traffic from 1825 on.[20] It was headquarters of the Saskatchewan Brigade, sending canoes and York boats as far east as Norway House. Local spruce made this an important boat-building centre as well.[21] The shift over to Red River carts in the mid 1800's resulted in the decline of river transportation.

Water transportation revived in the later 1800's with the coming of river steamers. The first of these reached Edmonton in 1875 from Grand Rapids at the mouth of the river[22] and the village became the head of navigation on the North Saskatchewan. Despite frequent difficulties due to seasonal fluctuations in river depth and to constantly shifting shallows, the river steamers operated effectively until the arrival of the railways. The last steamboat working out of Edmonton ceased operations in 1918. Since then smaller riverboats have carried excursion parties on a few occasions. As recently as 1942 it was suggested that a 1200-mile waterway between Edmonton and Winnipeg be undertaken as a postwar project, but nothing came of it.[23]

As mentioned earlier, the influence of the river and valley on land transportation has been chiefly restrictive. Such is the situation today. Other than railway crossings in the city, the problem of trans-river traffic is the most serious with which Edmonton must deal. Five bridges serve the city at present, the Groat Bridge having been opened as recently as 1955, but with a rapidly expanding population the problem continues to grow. The latest survey made in 1956 recommends not only improved conditions for existing bridges, and new bridges, but suggests that the same Valley which produces the problem may assist in its solution. An arterial roadway through the River Valley to relieve traffic on other routes was suggested and is in process of construction on the north side. The chief complication would seem to be the situation at the undercut bluffs where normal slumping is to be expected.

The steep valley sides pose problems for transportation routes. Roads seek easier gradiants by cutting up the slope diagonally.[24] The tributary ravines also provide useful routes for gradual ascent. Thus Mill Creek Ravine was utilized by the former Edmonton, Yukon, and Pacific Railway in order to reduce grades. Similarly the Groat Ravine has been made the route for an arterial cross-river roadway in the past few years.

Grierson Hill, a route of considerable traffic on the downtown margins, illustrates many of these problems. A diagonal road was constructed on the steep undercut bluff in order to provide access to the Low Level Bridge. Landslides have disrupted it ever since. The shore has been built up continuously with fill and riprap in order to check river erosion, but slippage has continued, as much as eight feet in a single year. Water seepage has been responsible, chiefly along coal seams in the river bank. Abandoned mine workings have aggravated this in that they have tended to collect more water. Drain holes and pumping failed to stop hillside movement and currently the city is pushing a 1300-foot drainage tunnel into the hillside in hopes of finally stabilizing the slope.

The water itself in the North Saskatchewan River has been a vital factor in the urban geography of Edmonton. For those people located on the flats, spring has been a season of anxiety in case of floods. Fortunately the incised river bed is sufficient to handle the increased flow in most years. Yet floods do occur. The shift of the fort from its first site near the present day power plant up onto the higher terrace seems to have been prompted by a desire to be free from floods. Even if the water does not inundate a large area, it disrupts conditions on the valley bottoms. Using the City datum of 2053 feet, at 2075 feet the Utilities are affected. Sewers back up and gas service must be cut off to the flats. 2080 feet is regarded as the flood danger point and water begins to lap up over the lowest portions of the valley bottoms. The two most serious floods on record were in August 19, 1899, and in June 28, 1915, when the water rose 41 feet and 45 feet respectively, above the datum point. The flats were completely covered with water and many inhabitants and industries never returned to the valley bottoms afterwards.[25] In 1899 the city power plant, then at the foot of McDougall Hill, was flooded to a depth of three to four feet and Edmonton was without power for three weeks. Subsequently the power plant moved to its present location at the north end of the 105 Street Bridge. Although still on the valley bottom, it is slightly higher land, and dikes around the installation will protect it against a water rise of up to 60 feet. Serious floods are not too frequent in Edmonton, however.

The low flow under winter conditions is a far more serious factor for Edmonton. In the long run, this may decide the size to which the city grows. Water is available generally in abundant supply from the River. Despite the great increase in population and industry in the last decade the city has kept pace in expanding its services. Since 1945 the annual consumption of water in the city has doubled, to 8,023 million gallons in 1957. 20 million gallons a day is the average daily consumption by the city, with 35 million gallons recorded in late May 1958. The

present capacity is 50 million gallons per day. In addition, the city power plant uses 100 million gallons a day independently, for its condensors.[26]

The river also receives the waste products from the city. In the summer there is no problem in this process. During the winter, however, the low flow plus the ice cover provide only a limited amount of oxygen in the river. This has been depleted dangerously in recent years by the wastes dumped into it. Downstream towns, cities, and industries which also depend on the North Saskatchewan for their water supply protested about its unsanitary condition. The situation has been corrected by more efficient treatment of waste products from Edmonton but such processes may be prohibitively expensive for some industries. It seems that if Edmonton is to continue to grow and to attract new industry, this problem must be faced up to. A likely solution is the construction farther upstream of water storage facilities in order to increase the winter flow of water in the River.[28]

Ice formerly was cut from the river upstream from the Groat Bridge in January and February. In 1927 for example, 47,000 tons was cut and two companies employed 100 men in the process; 25,000 tons went to Edmonton homes, dairies, and packing plants; 20,000 tons went to the railways; and 2,000 tons were shipped out to the small towns in the surrounding district.[29] Artificial refrigeration steadily reduced the demand, however, and the last ice was cut on the river in the winter of 1949-50.

Finally, the North Saskatchewan River and its valley must be assessed in its aesthetic and recreation value to the city. In this it is the city's greatest single asset. The valley crest provides view lots for the best residential properties, and at the same time there has been general agreement that its slopes and as much of the flats as possible should be devoted to recreation purposes for the citizens at large. Much of the bottom land was privately owned at an early date so that not all the valley is parkland at present. That

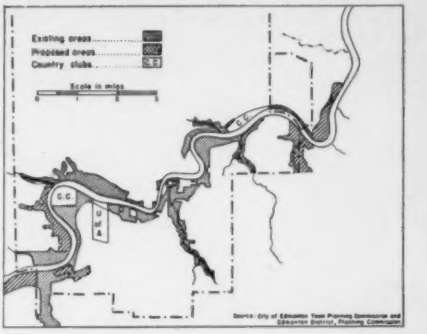

FIGURE 4. Edmonton — Recreation areas in the River valley.

which remained in natural condition, chiefly because of the steep slopes involved, now fortunately is protected by the city planning department.[30] The result is that Edmonton has one of the best population-park area ratios in Canada. A 1955 survey placed this at 19.6 acres of total open space (9.6 acres of which was developed) per 1000 population.[31] Of the total 3930 acres involved, significantly, 2884 acres were "River Valley and Ravines".[32] (Figure 4)

Yet as the city grows, the pressure on this open land by "promoters" increases. Concerted action by planning authorities was necessary recently to guarantee the future of Whitemud Creek valley as parkland. Conflict between arterial roadway planners and park supporters has broken out. This debate can only be resolved by compromise since each has a valid need to serve. The future Edmonton will need and benefit from every acre of parkland possible, particularly along the valley.

Every city has something which gives it a distinctive, unique character. It may be a blend of several features. To outsiders, Edmonton is perhaps best known as the "Gateway to the North", "Oil Capital of Canada", or "Fastest Growing City of Canada". To these should be added "River Valley City". Rarely has a river played a greater role in the life of a city than has the North Saskatchewan in that of Edmonton, Alberta. Today's

critical aspects of traffic, water, and parks may alter, but the river and valley will continue to bulk large in the Edmonton of the future.

REFERENCES

1. Conversations with C.P. GRAVENOR and R.N. FARVOLDEN, Research Council of Alberta.
2. *ibid.* The R.C.A. plans preliminary investigation into this in the summer of 1958.
3. "Saskatchewan" is a Cree Indian word meaning "swift flowing".
4. Dr. J. ALLEN quoted in *The Edmonton Journal*, Aug. 25, 1936.
5. Water Resources Division, Dept. Northern Affairs and National Resources, Ottawa.
6. City Water measurements take this winter water level of 2053 ft. elevation at the power plant as the datum point.
7. Conversation with E.L. SMITH, Chief Chemical Engineer, City of Edmonton.
8. Since May 1911 at Edmonton.
9. The first Fort Augustus of the Northwest Company and Fort Edmonton of the Hudson's Bay Company were built in 1794-95 on the north side of the river immediately below present day Fort Saskatchewan. Both were moved to the present site of Edmonton first in 1802, and permanently in 1812. After the union of the two companies in 1821 a single large Fort Edmonton was built on a river terrace below the present Legislative Building.
10. MacDONALD, G. H.: *Ft. Augustus - Edmonton*, The Douglas Printing Co., Ltd., Edmonton, 1954, and MacGREGOR, J. S.: *Blankets and Beads*, Inst. of Applied Art Ltd., Edmonton, 1949.
11. DOWLING, D. B.: *The Edmonton Coal Field, Alberta*, Kings Printer, Ottawa, 1910, p. 11.
12. The 4th through the 29th first officially registered coal mines in the province were recorded in the Edmonton area in 1896 and 1897 by the Mines Branch, Gvt. of Alta.
13. *The Edmonton Journal*, Nov. 10, 1953.
14. WONDERS, W. C.: *Repercussions of War and Oil on Edmonton, Alta.*, a paper presented to the Association of American Geographers, Montreal, April 1956.
15. DUTTON, J. A.
16. *Alberta Hist. Rev.* 4, 1956. p. 29.
17. *The Edmonton Journal*, Jan. 28, 1931.
18. *op. cit.*, October 14, 1932.
19. LITTLE, J. B. and Sons Ltd., Edmonton.
20. MacDONALD, G.H., *op. cit.*, p. 132.
21. Later, this same spruce was the basis for a considerable saw milling industry on the flats. After local supplies were exhausted, timber cut farther west was floated down river to Edmonton mills. Bad floods wiped out the mills and railways subsequently brought in the timber.
22. WICKENDEN, N.: North West and Minnow; *Alberta Hist. Rev.*, 5, 1957, 11-15.
23. *The Edmonton Journal*, Aug. 31, 1942.
24. The Edmonton Incline Railway Company Ltd., operated from 1908 to 1911 on McDougall Hill at 101 Street, to lift passengers and vehicles up the steep slope.
25. The 1915 flood rendered 2000 people homeless and caused $750,000 property damage - *Hydrometric Survey Report for* 1915, King's Printer, Ottawa, 1917, p. 92.
26. SMITH, E. L.
27. Winter flows of 1000 c.f.s. at Edmonton are usual, in the last few years 800 s.f.s. has been common, and 600 c.f.s. has been recorded on some days - E. L. SMITH.
28. The river has not been used for power purposes in the area. A water-powered grist mill was constructed on the lower part of Mill Creek in the 1870's but was not successful because there is usually insufficient water to operate it.
29. *The Edmonton Journal*, Jan. 6, 1927.
30. see DANT, N.: Edmonton: Practical Results of Planning Measures since 1950; *Commun. Planning Rev.*, IV, 1954, pp. 31-40.
31. *Report on Active and Passive Recreation, Park and Open Space Facilities Within the City of Edmonton*, Town Planning Dept., Edmonton, January 1955.
32. Use of the river itself for recreational purposes, such as swimming, boating, and fishing is not popular, due to the high turbidity, swift current, and low water temperature during the summer. Indeed, swimming in the river is prohibited by law.

TROPICAL AIR CIRCULATION
A REVIEW OF THE RECENT LITERATURE*

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ABSTRACT. *Since World War II research programmes on tropical meteorology have been greatly enlarged and much new literature on the winds and weather of the Tropics has appeared. Accord has been reached on the underlying physical bases of most circulation patterns, but sharp disagreement persists on some aspects, in particular those referring to tropical fronts. This paper attempts, within the framework of the classical circulation systems, the trades, doldrums and monsoons, to review the recent literature and to abstract what is most significant for the geographer.*

RÉSUMÉ. *Depuis le dernier conflit mondial, la recherche dans le domaine de la météorologie tropicale a connu un essor prestigieux et nombre d'ouvrages sur ce sujet furent publiés. Depuis lors, un accord est intervenu en ce qui concerne les causes physiques des principaux systèmes de circulation atmosphérique, mais quelques différences persistent toujours sur certains points, surtout ceux se rapportant à l'étude des fronts tropicaux. Cette étude pour sa part, examine les ouvrages récents traitant des systèmes conventionnels de circulation, tels que les alizés, les doldrums, et les moussons, et tente d'y en retirer ce qui est le plus significatif pour le géographe.*

In recent years, interest in tropical[1] meteorology has expanded greatly. Needs of the Second World War, the testing of nuclear weapons in the Pacific Ocean, and the remarkable growth of commercial air routes have resulted in the establishment of many new weather stations, the data from which have formed the basis of a greatly enlarged research programme on tropical meteorology.[2]

Probings of the upper air in particular have brought to light new information on the tropical atmosphere, making necessary the revision of some of the often repeated and tenaciously held classical theories, and the confirmation of others. Not all agree on the nature or basis of various aspects of tropical circulation, and on the question of tropical fronts, C.E. Palmer states: "To anyone who has had to review the literature on tropical fronts written in the last ten years, the effect is one of intolerable confusion"[3].

Nevertheless, accord has been reached on a fairly large number of topics, a selection of which comprise the substance of this paper. Essentially, this is a review of the recent literature, and, as such, offers no original thought on the subject and introduces no new factual material. It is directed to teachers of physical geography, and, therefore, attempts to describe as accurately as possible, and to define as precisely as possible the essential features of the weather of the trade winds, doldrums and monsoons.

TRADE WINDS

No one will deny that the trade winds are the most constant and the most reliable in the world. Above this broad, steady flow, however, air currents become increasingly variable, and profoundly influence weather conditions, making no thorough analysis of the trade winds possible without reference to their vertical structure as well as their surface characteristics.

SURFACE CONDITIONS

The classical description of trade winds blowing strongly and steadily from ENE in the northern hemisphere, and ESE in the southern hemisphere, applies mainly to the eastern tropical oceans. To the west, particularly in the northern hemisphere, the trades become increasingly variable, and are influenced by disturbances to such an extent that they only faintly resemble their counterparts to the east. Futhermore, the trades in the western oceans, especially in the summer hemisphere, tend to blow more away from than towards the equator (see Figure 1). At Pukapuka (11°S, 166°W), for example, the mean surface wind in summer is directed away from the equator, although this station lies south of the mean position of the equatorial trough of low pressure.

* Presented at the January 1959 meeting of the Southern Ontario Division of the Canadian Association of Geographers in Toronto, Ontario.

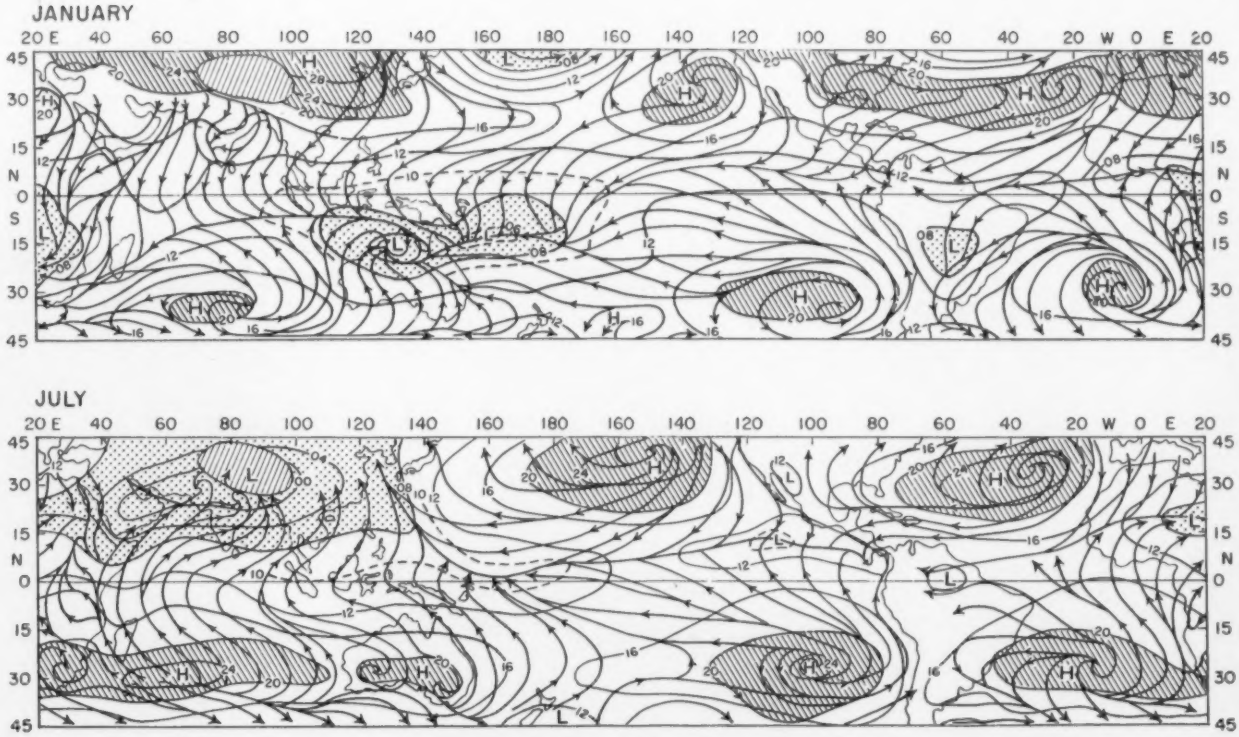


FIGURE 1. Streamlines and isobars for January and July. (Reproduced from H. Riehl, *Tropical Meteorology*, with permission of the McGraw-Hill Book Company).

Large cells of high pressure normally cover the oceans in sub-tropical latitudes, particularly in the northern hemisphere, and, as such, steer the trade winds in great anticyclonic whirls which account for their *mean* equatorward component in the eastern oceans and poleward component to the west. It was Bjerknes[4] who emphasized the rôle of the oceanic highs in the general circulation, and, among others, indicated that the roots of the trades are found in the eastern parts of their equatorial branches where air subsides from aloft and diverges horizontally (Figure 2).

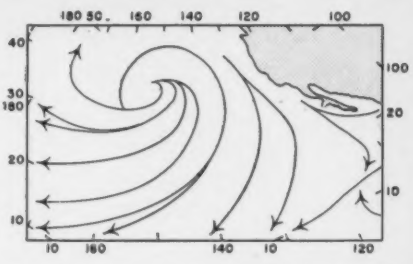


FIGURE 2. Mean surface streamlines for July for the Eastern Pacific Ocean (Reproduced with permission from *Tropical Meteorology*)

It is rather astonishing that few attempts have been made to define precisely the characteristics of the trades, and, therefore, make possible an accurate delimitation of their area of influence. Crowe[5,6] has quite recently studied the problem in great detail, and some of his conclusions are listed below, and are reproduced on Figure 3. Quite remarkable is the fact that there are areas within the trades where degrees of constancy of direction reach ninety per cent. A high positive correlation exists between constancy and speed, and in areas of greatest persistency of direction, average values of over sixteen knots are recorded. The strength of the trades nearly doubles from summer to winter, and, on the average, the strongest winds are found in the southern hemisphere, especially in the Indian Ocean in July. The most marked north-south seasonal migration of the trades occurs in the eastern oceans with diminishing migration to the west. Furthermore, what is usually not fully appreciated in the trade wind system, especially in the Pacific, is its marked advance westward in winter, and withdrawal eastward in summer.

It must be emphasized that the trades do not blow steadily at all times, but rather in pulsations. Trade winds may reach speeds of thirty miles per hour for several days; in contrast, there are periods in which the winds are light and rather variable[7]. For several days, the trades may surge strongly towards the equatorial trough where they converge into equatorial storms. Such a trajectory may then be replaced by one with anticyclonic curvature, and an associated poleward component.

UPPER WIND

At one time it was thought that at higher levels (above 10,000 feet) trade winds reversed direction, and persistent south westerlies (anti-trades) were characteristic. Data from upper air soundings, however, have contradicted this classical viewpoint[8]. The steadiness and uniformity of air flow in the lower levels gives way to extreme restlessness in the middle and upper troposphere, through which clockwise and counter-clockwise vortices frequently move, causing the winds to blow from many directions. Generally the basic current remains easterly to very high levels, but strong westerlies are observed often enough to make generalizations very difficult.

VERTICAL STRUCTURE OF THE TRADES

It is profitable to compare and contrast the vertical structure of the trade wind current over the eastern and western oceans. In the eastern oceans, the temperature of trade wind air is lower than that of the sea, resulting in the evaporation of large quantities of water vapour, which becomes thoroughly mixed in the lower 2,000 feet by turbulent eddies (Figure 4). Between 2,000 feet and 7,000 feet, the sky is partly covered by trade wind cumulus clouds, through which the energy derived from the sea is transported aloft. (Figure 5). It has been observed that these clouds form in irregular groups from five to thirty miles in width, separated by wider,

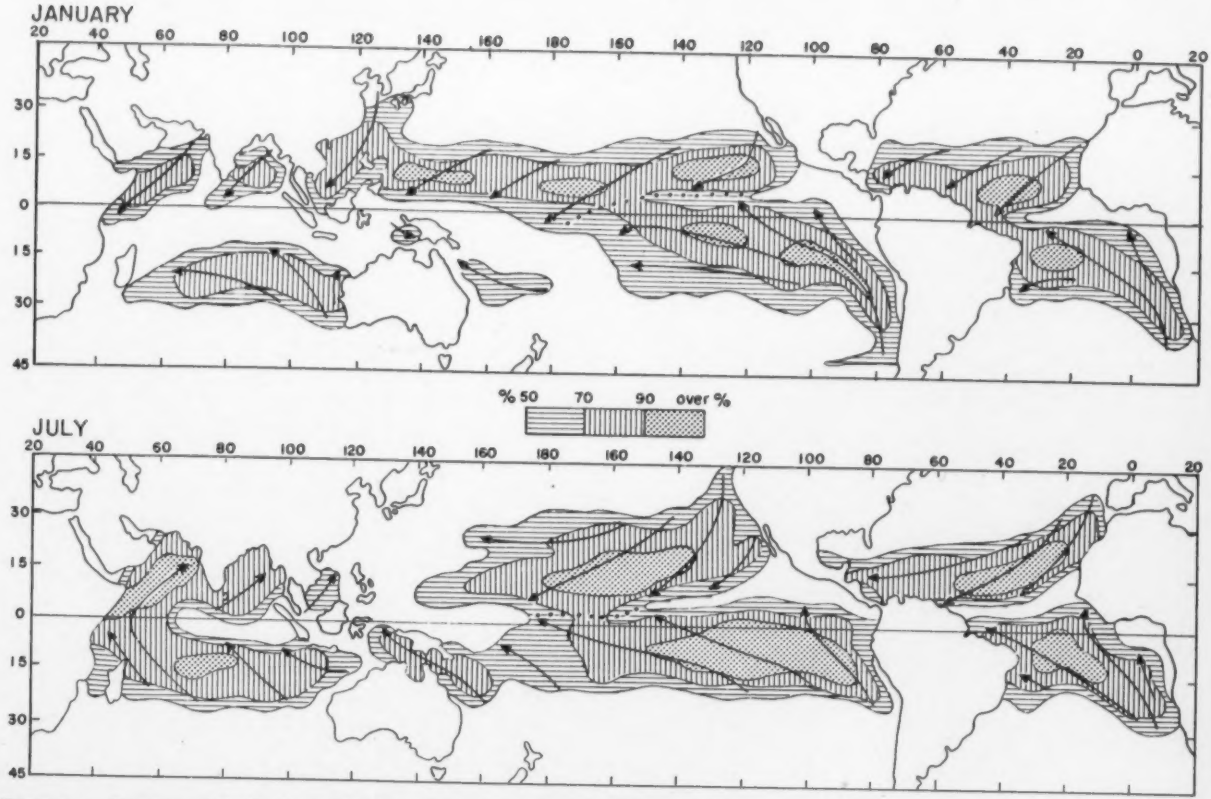


FIGURE 3. Constancy of the Trades in January and July. The frequency of winds within the predominant quadrant expressed as a percentage of all winds recorded within a unit area (after Crowe).

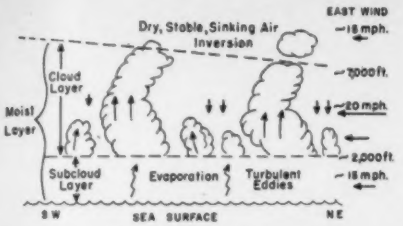


FIGURE 4. Schematic cross section along the path of the Trade Winds. Typical wind speeds at various levels are indicated by arrows at the right. (Reproduced with the permission of *Weather* and J. S. Malkus)

clearer areas[9]. Such patterns seem to vary little from day to night. Equatorward and westward, the clouds grow taller, heavier, and cover an increasing amount of sky. In the eastern oceans in particular, the height of the cloud tops is remarkably uniform, marking a strong inversion which impedes further vertical development of the clouds. This inversion is caused by large scale descent of air from the middle and upper troposphere, especially in the eastern portions of the sub-tropical high pressure cells. As Figure 6 indicates, the height of the base of the inversion rises, and the intensity of the inversion weakens downstream in the trade wind current. In the western oceans, the inversion often disappears in stormy disturbances, and clouds build up to great heights from which rain showers frequently fall (Figure 6).

THE ENERGY OF THE TRADES

While blowing across vast expanses of warm water, the trades gain enormous amounts of energy (sensible and latent heat) which may be considered as fuel, driving not only the trade winds but also most of the winds of the globe. Malkus, in discussing the magnitude of the energy derived from the tropical oceans, offers the following illustration: "If an area of one half square mile is fifty per cent covered with trade cumulus, only a small fraction of which need be rising at one time, they can easily provide a net upward transport of latent energy in water vapour equal to that provided by a thousand pound bomb of TNT exploding every minute. If this is summed up over all the tropical oceanic areas normally covered by trade cumulus, a net upward transport of latent energy is given which is greater by a factor of 40 or 50 than the rate of kinetic energy dissipation by all the wind systems of the globe. Thus the atmosphere is an inefficient heat engine, wasting much of the energy released by its water vapour fuel, a large fraction of which is lost by re-radiation to space in tropical and sub-tropical latitudes."[10] It follows that the lid created by the trade wind inversion in the eastern oceans is a very important regulatory valve in the circulation, because, without it, clouds would build to great heights and energy would be prematurely released[11].

STORMS IN THE TRADES

The trade winds are subject to wave-like perturbations quite uniform in wavelength and speed of propagation, but differing greatly with respect to stability and instability (Figure 7). Unstable waves become proper storms, some of which assume the size and vigour of hurricanes and typhoons. The world-wide pattern of these so-called easterly waves is, as yet, not entirely known, but their influence in terms of rainy, windy weather is chiefly in the western tropical oceans, and mainly in the summer. They have been studied most carefully in the Caribbean Sea and the Western Pacific Ocean. In the Caribbean, large scale sinking and horizontal divergence of air, clear weather, and surface winds blowing from the east-northeast characterizes conditions ahead of a typical wave trough. Very marked horizontal convergence, heavy, towering clouds able to penetrate great heights because of the disappearance of the trade wind inversion, east-southeast winds and frequent showers are found to the rear of the trough (Figure 8). Such an easterly wave may deepen considerably, and form a closed, low-pressure vortex, increasing the convergence, and enlarging the area of windy, wet weather (Figure 9). A few continue to grow in size and intensity, and may eventually develop into a Caribbean hurricane or a Pacific typhoon.

In the winter season, disturbances in the trade winds are less frequent and much

FIGURE 3. Constancy of the Trades in January and July. The frequency of winds within the predominant quadrant expressed as a percentage of all winds recorded within a unit area (after Crowe).

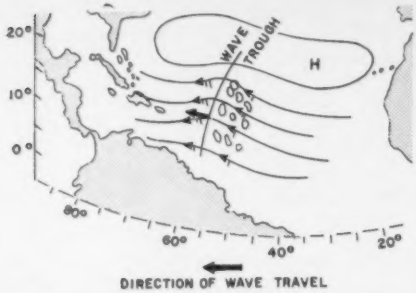


FIGURE 7. Surface streamline pattern in a typical easterly wave in the West Indies (Reproduced with the permission of *Weather* and J. S. Malkus)

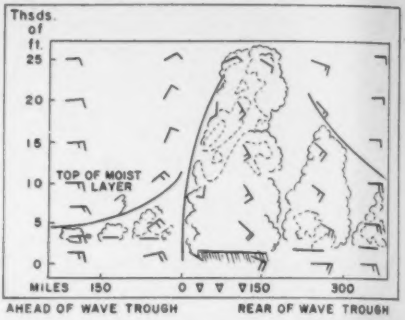


FIGURE 8. Vertical cross section through the wave shown in Figure 7. Cloud forms are shown schematically and are not to scale. Horizontal winds are denoted by the barbed lines, each short barb representing 5 m.p.h. The triangles indicate showers and rain. (Reproduced with the permission of *Weather* and J. S. Malkus.

weaker than in the summer. They usually develop from the intrusion of high level Polar westerlies into the Tropics and the resultant wave troughs normally move from west to east. It is thought that cut-off pools of cold air aloft, floating through the Tropics will cause the formation of what Simpson[12] calls "subtropical cyclones". Such storms have profound geographical significance in causing some of the winter rain in the sub-tropics. The Polar front occasionally moves through the western trade wind belt in winter, followed by continental Polar air which becomes rapidly modified over the warm water. Light rain or drizzle will usually accompany such a frontal passage.

EQUATORIAL CIRCULATION

It seems desirable to regard the area between the trade winds as one with a relatively low pressure, a comparatively flat pressure gradient and associated, variable circulation, and one in which considerable rainy, cloudy weather develops from atmospheric disturbances of varying intensity. The latitudinal extent of this zone with respect to either mean annual position or seasonal migration, varies greatly from one equatorial area to another. Most of the storms affecting this area are low pressure systems which move along wave troughs in lines or bands within the general area of low pressure. It is suggested that the old-fashioned term "doldrums" be used to describe the zone affected by equatorial weather disturbances and the term "equatorial trough" be used to describe the most important and most persistent line of equatorial storms.

EQUATORIAL TROUGH

The computed mean annual position of the equatorial trough is 5°N latitude, referred to as the meteorological equator. It has only limited significance, simply because the trough oscillates widely with the seasons in some areas and very little in other areas (Figure 10). Over most of the western hemisphere, the trough shifts less than four hundred miles, but, in

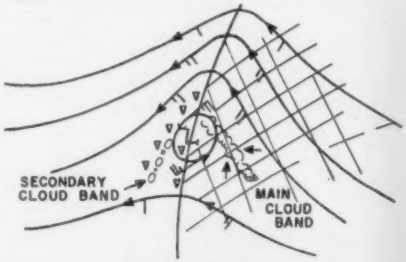
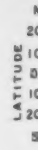


FIGURE 9. Schematic picture of a very deep easterly wave showing streamlines and the major cloud bands. Note the closed central vortex with wind turned all the way to the southwest at its southern rim. Other subsidiary cloud bands (not shown) are numerous throughout the rain area which is indicated by hatching (Reproduced with the permission of *Weather* and J. S. Malkus).

FIGURE 5. A broken Trade Wind cumulus sky at about 8000 ft. over the Caribbean area in summer. The top of the cloud layer is remarkably uniform,indicating the height of the Trade Wind inversion. (Courtesy J. S. Malkus and the Woods Hole Oceanographic Institute)

FIGURE 6. Trade Wind cumulus *congestus* within a disturbance over the Pacific Ocean near Wake Island, at 8000 ft. in August. (Courtesy J. S. Malkus and the Woods Hole Oceanographic Institute)


LATITUDE

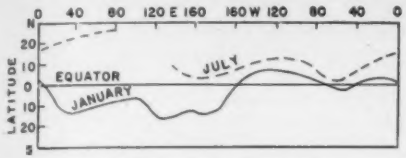


FIGURE 10. Mean positions of the equatorial trough. (Reproduced with permission from *Tropical Meteorology*)

contrast, over vast areas in the eastern hemisphere, particularly eastern Asia, shifts to the north and south of the equator frequently total two thousand miles. The trough is by no means continuous around the globe at all times. It may be very active in one area and very weak or entirely lacking in another.

The equatorial trough is disturbed by waves which, like the aforementioned easterly waves in the trades, move downstream. As these waves are increasingly amplified, low pressure vortices form which travel through the trough. Convergence with heavy rain is thereby concentrated into a few portions of the trough, intervening sections remaining relatively inactive. The usual sequence is for the trough line to form fairly close to the equator and then surge poleward. It becomes increasingly affected by wave-like disturbances which cause trade wind air and equatorial air to converge into their developing vortices (Figure 11). Eventually they weaken and then dissipate while a new formation takes place near the equator[13].

Disturbances in the trough account for most of the rain, not only over the oceans, but also over the land. The control of rainfall is not of a simple thermal kind, and the concept of large, isolated cumulonimbus clouds producing most of the rain in afternoon showers must be modified. On most occasions rainfall is associated with a few relatively narrow zones of disturbed weather within which, however, local convection, brought about by relief barriers or other factors, may augment totals considerably. As pointed out by Riehl, heavy rains in the Tropics fall on only a relatively small number of days[14]. One of these equatorial lows may be greatly deepened by the equatorward intrusion of a high level wave trough from the westerlies. Some of the heaviest rain in equatorial areas occurs under these conditions, mainly in the spring and the fall. In midsummer when the mid-latitude troughs are weak and cannot easily enter low latitudes, the cyclones are weaker and rainfall is less.

In the Pacific Ocean, such equatorial waves typically move from east to west, deepening in the West where a few develop into tropical cyclones. By no means is the basic current always easterly. Evidence suggests that there are bands of westerlies in the trough, extending to high levels, and the disturbances which perturb the flow are then propagated in an eastward direction. Detailed observations in the Belgian Congo show that westerly currents are quite common[15].

When the trough moves further than three degrees from the equator, it is usually marked by a sharp cyclonic wind sheer. Because the trough is normally oriented in a general east-west direction, weather stations north of the trough in the northern hemisphere record easterly winds and those to the south westerly winds. As the trough oscillates greatly, and may pass over a station several times in a month, rapid

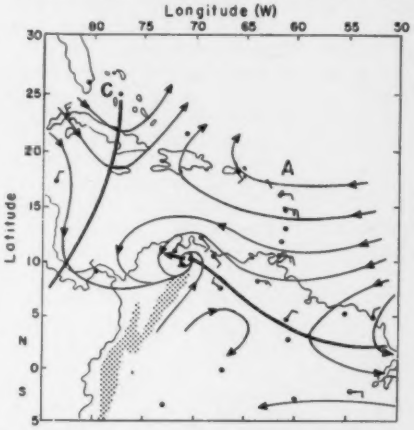


FIGURE 11. Streamlines at 4,000 to 6,000 feet, April 28th, 1952. A indicates anti-cyclonic, C cyclonic, circulation. Note that part of the trade winds converge into the equatorial low and part curve poleward over the west Indies. (After Riehl and Byers).

variations between easterly and westerly components will be observed. When the wind statistics are averaged out, no predominant quarter shows up and the conclusion that the winds are variable is reached. Could this not be the essence of the variable winds of the doldrums ?

It follows that stations in the northern hemisphere remaining south of the trough over long periods will record a large number of westerly winds. In fact, the persistence of westerly winds near the equator has led both Fletcher[16] and Flohn[17] to recognize them as a major current in the general circulation of the atmosphere, to the north and south of which the trades converge into storms formed along not one but two troughs of low pressure. Palmer [18] adopts an opposite view, and emphasizes that the observed equatorial westerlies are merely the statistical result of the passage of low pressure systems both to the north and south of the equator. The question of the significance of equatorial westerlies will not be answered until the wind record in equatorial areas is more complete.

DOLDRUMS

The interpretation of equatorial meteorology derived from sorting out the various comments in the recent literature is that of a zone of doldrums through which the equatorial trough and its associated weather disturbances move. Some equatorial areas are affected more than others, and the following is an attempt to recognize the regional variations in the extent of the doldrums. It is possible to relate Crowe's very fine study of wind and weather in the equatorial zone[19] to this interpretation, at least as far as the oceans are concerned[20]. The continents present a more formidable problem.[21]

By far the largest pool of doldrums surrounds the equator in the Western Pacific, and extends through south eastern Asia and the Indian Ocean almost to the coast of Africa, and is referred to as the Indo-Pacific doldrums (Figure 12). At its greatest extent, it encompasses an area of at least ten million square miles. Much smaller, and somewhat triangular in shape, are the zones of doldrums off the west coast of Middle America in the Pacific Ocean and the west coast of Africa in the Atlantic. As Crowe points out, "these doldrum wedges are clearly affected by the trend of the coast which sets the root of the north east trades some thirty degrees to the west of that of the south east trades".[22]

In July, the Atlantic zone of doldrums extends to the coast of Brazil with a mean axis around latitude 8°N. It is found inland and encompasses northern South America, north of about latitude 3°N. In January the doldrums are found through the Amazon Basin and as far south as Paraguay. The zone of doldrums in the Pacific Ocean to the west of Middle America, frequently affected by active equatorial storms, extends further east in July than January. Approximately at longitude 135° W, it becomes very narrow or disappears entirely. The weakness of equatorial disturbances over much of the Central Pacific Ocean is reflected in the low rainfall of this area. On many maps the trade winds are shown to be converging constantly in this area. In reality, they tend to blow parallel to one another, and convergence is brought about only by the occasional development of an equatorial disturbance. In Africa the zone of doldrums oscillates widely, reaching latitude 15°N in July and 20°S in January. The northern portion of Australia is encompassed by doldrums in January as is most of India in July.

FRONTS[23]

At one time it was thought that the equatorial trough contained a more or less continuous front (inter-tropical front), marking a line of discontinuity between the trades, encircling the globe, and oscillating with the seasons. Riehl, however, points out that the northern and southern trade winds which blow over the oceans and reach the trough do so after a complete equalization of their thermodynamic properties[24]. If and when they converge, no density discontinuity can be observed, and, consequently, there is no justification for drawing a front.

The problem of whether fronts exist over the land in West Africa and India and other tropical areas has not, as yet,

been solved. It was pointed out at the beginning of this paper that considerable confusion exists regarding the existence of fronts. Palmer[25], writing in the Compendium of Meteorology, has compiled a list of quotations from different writers to emphasize the nature of the contradictory opinions. A few of the apparent inconsistencies are set down as follows.

1) The equatorial front is single and continuous.
2) The equatorial front is part single and part double.

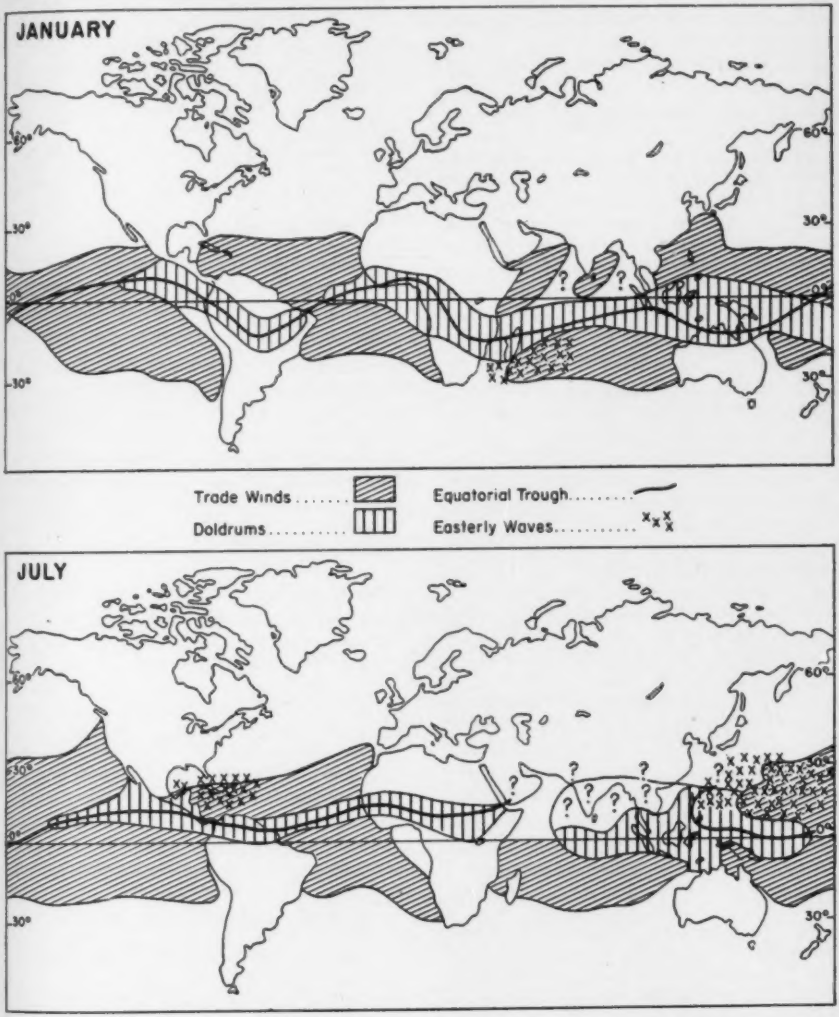


FIGURE 12. A Very generalized representation of areas of the trade winds, doldrums, easterly waves and equatorial trough for January and July. (Mainly after Crowe and Riehl)

3) The equatorial front is double.
4) The equatorial front is discontinuous. There are many equatorial fronts.
5) The equatorial front may slope toward the summer hemisphere.
6) The equatorial front may slope one way in the lower atmosphere and in the opposite way in the upper atmosphere.
7) The equatorial front does not slope at all.

UPPER WINDS

Evidence on the nature of the equatorial air circulation at higher levels is still fragmentary, but there is a general agreement that westerly winds are recorded most frequently in the middle and upper troposphere. In the northern hemisphere summer, the band of upper westerlies broadens and strengthens considerably to cover the area between the equator and the Tropic of Cancer from West Africa to the Philippines.

In the stratosphere there has been observed a rather curious zonal circulation, consisting of two rings of oppositely moving air. In the low stratosphere (twelve miles), a narrow thread of west winds blows steadily along an axis which lies at 2°N latitude[26]. Above this level strong easterlies are found which were first discovered following the volcanic eruption of Krakatoa in 1883. Wexler[27] has related the circulation of the cloud of fine volcanic dust, resulting from the explosion, to upper air data which have recently been compiled. He concluded that " . . . the main body of the cloud moved from east to west at an average speed of 73 mph, completing at least two circuits of the earth in equatorial latitudes". The term "Krakatoa easterlies" has been coined to describe these persistent equatorial winds at approximately eighteen miles.

THE SUMMER MONSOON IN INDIA

No summary of tropical circulation would be complete without a few comments on the monsoon, in particular that of India. Many words have been written and many maps been drawn to describe and analyse the characteristics of the Indian monsoon.

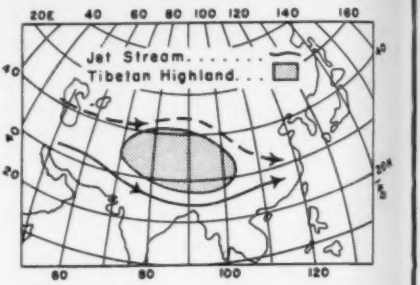


FIGURE 13. Change in flow pattern resulting from the displacement of the jet stream to the north and south of the Himalayas. (Reproduced with permission from *Tropical Meteorology*).

It has been repeatedly pointed out that intense heating over the land results in the formation of a deep thermal low into which warm, moist winds of the Indian Ocean pour, their direction being determined by the particular orientation of the wall of mountains to the west, north and east of India. It is a fact that the monsoon spreads over Burma before it does over India, and that its arrival in India is of a rather spectacular nature to warrant the descriptive term "burst". Recently, detailed studies of the upper winds over the region have resulted in the presentation of a new explanation of the delay of Indian monsoons. A summary of these findings will now be attempted[28].

In the winter season, one branch of the upper level Polar westerlies blows south of the Himalayas, the orientation and height of which prescribes the mean location of a high level trough of low pressure over the Bay of Bengal along approximately longitude 90°E (Figure 13). Because of the continued deformation of the westerly flow around the huge elliptical-shaped high plateau of Tibet until normally late spring, the trough of low pressure persists over the Bay of Bengal until about late May or early June. To the west of the trough, an upper level ridge of high pressure causes the high level westerlies to subside over most of India, thereby retarding the monsoon and resulting in cloudless skies. Intense solar heating makes the air temperature rise to very high values (pre-Monsoon heating) over

India and Pakistan, and a thermal low to form as early as April. To the east of the trough, high level southerly winds accelerate the monsoon over Burma and the Bay of Bengal, and heavy rains fall during the spring. It has been proven that some of the air supplying this moisture to Burma had previously moved over India where it had failed to yield rain because of the persistence of the ridge of high pressure. Rather suddenly in late May or early June, the trough of low pressure over the Bay of Bengal moves westward and assumes a mean position around longitude 75°E. Its position over the Bay of Bengal becomes untenable when the southern branch of the polar westerlies quickly retreats to the north of the Himalayas. Southerly wind components then allow the deep invasion of the equatorial trough and heavy rains begin to fall.

To quote Riehl, "It follows that the change in upper circulation can explain the pattern of the advance of the monsoon. This hypothesis permits us to relegate the heat low over northwest India and Pakistan, often cited as the primary factor in the advance of the monsoon, to a more secondary role. The heat low arises from intense insolation under clear skies over a wide area. However, clear skies cannot be considered as an *a priori* factor in any monsoon theory ; it is just another way of saying that the monsoon is retarded.[29]

It is unfortunate that an impression was created many years ago that the monsoon blows steadily during the summer and rain falls almost continuously. In reality, there is a great variety of flow patterns, and rain may not fall for periods as long as two weeks. Furthermore, although orographic rain is undeniably important, it is by no means the only type. Disturbances on the equatorial trough produce heavy rains, and their periodicity accounts for the irregular distribution of precipitation. Closed, low pressure vortices may be observed to move inland from the Indian Ocean suggesting that the classical explanation of thermal lows forming over the land and causing convectional rain must be modified.

SUMMARY

To sum up, the following comments are offered.

Upper air circulation in the Tropics can no longer be ignored in any study of the dynamic climatology of low latitudes.

The trade winds undergo considerable modification as they blow over the warm oceans. In the eastern oceans they are relatively dry and stable (aloft), and here they attain the highest degree of constancy of direction. To the west they become increasingly disturbed by easterly waves, and rainfall increases accordingly. Where the trajectory over the ocean is short (South Atlantic Ocean) such modification is normally not accomplished ; where it is long (over the Pacific Ocean) great modifications take place.

There is no *constant* convergence of the trades at or near the equator, and the clash of the trades depicted on models of the general circulation is, for the most part, imaginary. Really significant convergence occurs only in organized disturbances. Many of the trade wind currents never reach the equator, having veered poleward around the western branches of the sub-tropical oceanic highs. On the other hand, trade wind currents will, from time to time, cross the equator and deeply penetrate the opposite hemisphere. It bears repetition that the trades blow in surges, their trajectories being determined by the particular orientation of pressure systems.

Most of the rain in the low latitudes comes from organized disturbances and not from isolated "heat" thunder showers. Land elevations, however, influence the distribution of rain very greatly and, for example, the windward slopes of oceanic islands receive much more rain than their leeward counterparts. The frequency and intensity of both equatorial weather disturbances and trade wind weather disturbances varies greatly from one region to another, and from one year to another. More studies are urgently needed, however, to define more precisely rainfall variability in the Tropics which appear to be higher than at once thought.

REFERENCES

1. In this paper, the term "Tropics" refers to the area of the low latitudes between latitude 30°N and 30°S. The term "equatorial" is a further refinement, and refers to the area on or near the equator. The reader should be reminded that warm oceans cover almost eighty per cent of the area under study.
2. To a great extent, however, the distribution of meteorological stations in the tropics remains uneven, and large areas, such as the Amazon Basin and the Southeast Pacific Ocean, contain a very sparse network.
3. PALMER, C.E. : Tropical Meteorology ; in T. Malone (editor), *Compendium of Meteorology 1951*, Amer. Met. Soc., p. 868.
4. BJERKNES, J. : La Circulation Atmosphérique dans les Latitudes Sous-Tropicales ; *Scientia* (Rivista di Scienza), 57, 1935, pp. 114-123.
5. CROWE, P.R. : The Trade Wind Circulation of the World ; *Inst. Brit. Geog. Trans. and Papers*, 15, 1949, pp. 37-56.
6. CROWE, P.R. : The Seasonal Variation in the Strength of the Trades ; *Inst. Brit. Geog. Trans. and Papers*, 16, 1950, pp. 23-47.
7. RIEHL, H. : *Tropical. Meteorology*, McGraw Hill, Toronto, 1954, p. 273.
8. RIEHL, H. : On the Role of the Tropics in the General Circulation of the Atmosphere; *Tellus*, 2, 1950, pp. 1-17.
9. MALKUS, J.S. : Trade Cumulus Cloud Groups : Some Observations Suggesting a Mechanism of their Origin ; *Tellus*, 9, 1957, pp. 33-44.
10. MALKUS, J.S. : Aeroplane Studies of Trade-Wind Meteorology ; *Weather*, 8, 1953, pp. 293-4.
11. RIEHL, 1954, *op. cit.*, pp. 53-70.
12. SIMPSON, R.H. : The Evolution of the Kona Storm — a Sub-Tropical Cyclone ; *J. Met.*, 9, 1952, pp. 24-35.
13. RIEHL, H. and H.R. BYERS : *Flood Rains in the Bocono Basin, Venezuela*, a Report for the Ministry of Public Works, Republic of Venezuela, Univ. of Chicago, 1958, p. 11.
14. RIEHL, 1954, *op. cit.*, pp. 88-97.
15. BULTOT, F. : *Sur le Caractère Organisé de la Pluie au Congo Belge*, l'Institut National pour l'Etude Agronomique du Congo Belge, Bruxelles, 1952.
16. FLETCHER, R.D. : The General Circulation of Tropical and Equatorial Atmosphere ; *J. Met.*, 2, pp. 167-174.
17. FLOHN, H. : Passatzirkulation und Aquatoriale Westwindzone ; *Archiv für Meteorologie Geophysik und Bioklimatologie, Ser. B.*, 3, 1951, pp. 3-15.
18. PALMER, *op. cit.*
19. CROWE, 1949, *op. cit.*
20. According to Professor Crowe : "The doldrums are areas of tropical seas where less than fifty per cent of all winds blow from the predominant quarter".
21. Data are insufficient to draw with any precision the boundaries of equatorial trough weather over the continents. The descriptions herewith set down are very general indeed. It was suggested to me by Professor Riehl recently in a letter that a climatological study of some significance would be the construction of a diagram containing the relative frequency of equatorial trough and trade-wind weather on a percentage basis by areas. He cautions, however, that the necessary data and maps for such an investigation may, as yet, not be available.
22. CROWE, P.R. : Wind and Weather in the Equatorial Zone ; *Inst. Brit. Geog. Trans. and Papers*, 7, 1951, pp. 21-76.
23. Fronts, if they exist at all in low latitudes, have a very much different physical basis from their counterparts in the middle and high latitudes. Geographers would be well advised to use the term "equatorial trough".
24. RIEHL, 1954, *op. cit.*, p. 238.
25. PALMER, *op. cit.*
26. PALMER, C.E. : The General Circulation Between 200 mb. and 10 mb. over the Equatorial Pacific ; *Weather*, 9, 1954, pp. 341-9.
27. WEXLER, H. : Spread of Krakatoa Volcanic Dust Cloud as Related to High Level Circulation; *Bull. Amer. Met. Soc.*, 32, 1951, pp. 48-51.
28. YIN, M.T. : A Synoptic-Aerologic Study of the Onset of the Summer Monsoon over India and Burma ; *J. Met.*, 6, 1949, pp. 393-400.
29. RIEHL, 1954, *op. cit.*, p. 259.

IDEALIST HISTORY AND HISTORICAL GEOGRAPHY*

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ABSTRACT. *The philosophy and methodology of history are significant to historical geography. In the last fifty years the Idealist view of history has become important. In its classic form, as presented by R. G. Collingwood, this states that history is the study of ideas and that the method of historical study consists in the historian rethinking the thoughts of the past. The relations between historical phenomena are internal and the criterion of truth is coherence.*

This is in contrast with the Positivist view. The latter, by its discrete classifications and emphasis on causal relations, might appear to be more relevant to historical geography. Yet the Positivist explanation can only be partial. This is an epistomological as well as an empirical problem. In practice, most historians now employ some form of Idealist methodology, even if they do not subscribe to the Idealist philosophy. Whatever the particular concern of a study, the Idealist method helps to give a more complete explanation. This is summed up in Oakeshott's statement that the "only explanation for change is a complete description of change". The Idealist method leads to the treatment of the physical environment as a particular, rather than a general, determinant. In substantive form, the Idealist approach to historical geography, whether overtly stated or otherwise, is shown in certain works of Collingwood, Stanislawski and Brown.

These particular studies, too, show or imply the limitations of the Idealist approach. The method can only be used for the historic, literate, period. Prehistoric periods must be treated by the methods of natural science. This limitation is implied, paradoxically, in Croce's "Ligurian" statement. Renier's criticism of this is not really relevant.

The utility of the Idealist view, at present, lies only in the study of the historic period.

RÉSUMÉ. *La Philosophie et la Méthodologie Historique peuvent être d'un précieux secours en Géographie Historique. Durant les cinquante dernières années, l'interprétation "Idéaliste" de l'Histoire a pris beaucoup d'importance. Dans sa forme classique, comme le dit R.G. Collingwood, cette méthode veut que l'Histoire soit l'étude des idées et que la Méthodologie Historique consiste, pour l'historien, à repenser les idées du Passé. Les rapports entre phénomènes historiques relèvent de leur nature propre et le critère de vérité en est la cohérence.*

Ceci est en contraste avec le point de vue Positiviste. Cette dernière méthode de par ses divisions bien définies et de par l'importance accordée aux relations causales pourrait paraître mieux convenir à la Géographie Historique. Cependant l'explication Positiviste ne peut être que partielle. Ce problème est d'ordre épistémologique aussi bien qu'empirique. En fait, la plupart des historiens, tout en ne souscrivant pas aux conceptions de la Philosophie Idéaliste, utilisent une forme mitigée de la Méthodologie Idéaliste. Quel que soit le problème étudié, celle-ci permet une explication plus complète. Ceci a été résumé dans la citation suivante d'Oakeshott : "the only explanation for change is a complete description of change". La Méthode Idéaliste considère le milieu physique comme un facteur déterminant particulier, plutôt que général. Le point de vue Idéaliste appliqué à la Géographie Historique apparaît, explicitement ou implicitement, dans certains travaux de Collingwood, de Stanislawski et de Brown.

En outre, ces études laissent percevoir les limites de la méthode Idéaliste. Cette méthode ne peut être employée que pour la période historique. La Préhistoire, par contre, doit être étudiée au moyen des méthodes particulières aux Sciences Naturelles. Paradoxalement cette restriction apparaît dans la déclaration "Ligurienne" de Croce. A cet égard la critique de Renier ne semble pas opportune.

A l'heure actuelle, la méthode Idéaliste ne semble pouvoir s'appliquer qu'à la période historique exclusivement.

The Idealist philosophy of history has become increasingly important in the last fifty years. Almost all modern books concerned with the nature of history give considerable attention to the Idealist view.[1] Philosophy of history is of direct practical importance to historical geography, whichever particular view of the nature of historical geography is held. This importance is the greater in the absence of a comparable conceptual basis peculiar to historical geography itself.

The antecedents of the Idealist philosophy of history are to be found in the works of Dilthey.[2] The concepts embodied in this philosophy were first formulated by Croce.[3] These concepts were adapted and given classic expression by Collingwood, although much of his work on this subject is contained in unfinished essays that were published posthumously.[4] Collingwood was also influenced, especially in epistemological matters, by the work of Oakeshott.[5] When treating of it in the objective sense,

* Presented at the Ninth Annual Meeting of the Canadian Association of Geographers, Saskatoon, 1959.

the Idealist philosophy holds history to be thought in action. It is held that by virtue of the common faculty of mind, the thoughts of the past can be re-thought by the historian. According to the Idealist philosophy, this constitutes the only possible valid knowledge of the past.

These propositions are made in terms of a critical philosophy. It is not proposed to consider here those aspects of the Idealist view that constitute a speculative philosophy : such as, for example, that philosophy is a part of history. Nor is it strictly necessary to consider the epistemological aspects of the Idealist view : that the criterion of truth is coherence. It is desirable, as Kroeber has rather inelegantly phrased it, that methodology should "square with" philosophy,[6] but it is possible to practise a method without necessarily subscribing to the philosophy from which it is derived.

The Idealist philosophy is in contrast to that of Positivism. In its classic expression, Positivist philosophy emphasized the singularity of branches of knowledge, although this aspect is no longer held by modern Positivists such as Gardiner[7] and Popper.[8] Its methodology is derived from that of the natural sciences, Comte's original formulation of the Positivist philosophy having been a deliberate attempt to use the methods of natural science in the study of history. The study of history then becomes the application of common sense, and the intellectual aim of history is to transform itself into sociology. The epistemological basis is that the criterion of truth is correspondence, which involves the assumption of the existence of an irreducible body of fact.

The Positivist methodology might appear to be more relevant and useful to the study of historical geography than the Idealist methodology. In the exercise of Positivist method, phenomena are considered as being discrete and the causal relations between them external. The methodology consists, apparently, in no more than the careful exercise of those techniques of analysis, classification and synthesis commonly held by all who subscribe to the "scientific method". It is certainly a less esoteric method than that advocated by the Idealists. The reasoning proceeds by demonstrable steps — hence the criterion of correspondence — and there is no recourse to the intuitive process necessary in the exercise of the Idealist method.

Yet an explanation that relies solely on Positivist methodology can only be a partial one. Classificatory systems are static, but whatever else it is concerned with, the study of history is concerned with change. When a static system is employed as a method of study, causal relations cannot be considered as other than external. Yet there are many historical situations that, in the present state of intellectual inquiry, can only be regarded as *sui generis*.

There are other, more immediately practical, objections to a complete reliance upon Positivist methodology. These objections are not so much inherent to the methodology itself, as to the undue concentration upon that methodology. Concentration can lead, paradoxically, to a denial of that common-sense approach that is one of the attractions of Positivism. In conjunction with the desire to formulate laws that is characteristic of all scientific method, it can lead to the extreme and untenable positions such as those claimed by Huntington.[9] Positivist methodology, in its formulation of laws, panders to the widespread need for reassurance of the orderliness of things. It is particularly dangerous in historical geography in respect of enquiry as to the influence of the physical environment upon human society. By being studied in isolation, ie. as a discrete entity, the physical environment becomes the source of a cause external to society. The study of the physical environment as a discrete entity and an external cause leads to it being classified as a general determinant. Most of the excessive statements made in support of environmental determinism are due to a failure to distinguish between the general and the particular.

This distinction is observed in the substantive writings of the Idealists, although it is given little explicit expression in their theoretical statements. In Idealist methodology a distinction is made between actions and events. It is maintained that only actions, the results of appreciable

human thought, are a part of history. As a result of their insistence on this distinction, the Idealists are often accused of ignoring non-human occurrences. The accusation is unjust. Idealist methodology takes cognizance of these occurrences and denies only that they are themselves a part of history. Renier, for example, in criticizing Idealist methodology, has written that a history of the Low Countries in the fifteenth century that took no account of the change in flow of the Gulf Stream would be incomplete.[10] No one would deny this, but it was not the change in the Gulf Stream that was important to the course of society. Nor, as has been suggested elsewhere,[11] did the importance lie simply in men's awareness of the change. Rather was it in men's awareness of the results of the change, ie. that fish were to be found in parts of the seas different from where they had been found at an earlier period. The concentration on the ideas rather than the physical factors with which they are associated militates against the extremes of determinism.

The avoidance of these extremes is itself an aid to the colligative process. A complete history, or historical geography, is impossible to achieve. In spite of his opposition to it on strictly logical grounds, what Russell has called the Tristram Shandy paradox is but one practical bar to the construction of such a complete work.[12] Nevertheless, all histories and historical geographies are essays at completeness in their own terms and colligation is essential to such attempts. Oakeshott stated this succinctly, in his examination of the nature of historical experience " . . . the only explanation of change relevant or possible in history is simply a complete account of change. History accounts *for* change by means of a full account *of* change. The relation *between* events is always other events, and it is established in history by a full relation *of* the events. The conception of cause is thus replaced by the exhibition of a world of events intrinsically related to one another in which no *lacuna* is tolerated" [13]. This statement, translated into methodological terms, is an endorsement of the colligative process. Oakeshott went on to reinforce this statement, and to deny the extremes of determinism, by writing that, in history, "There is no 'main stream', no essential core in terms of which explanation can be offered".[14]

In substantive form, the Idealist approach to historical geography, whether overtly stated or otherwise, is shown in certain works of Collingwood, Stanislawski and Brown. Of these three writers, Collingwood is the only one who is known as an Idealist. In certain respects, however, the works of both Stanislawski and Brown show the use of something approaching Idealist methodology.

Collingwood's last major book on Roman Britain stands in a somewhat similar relation to historical geography as does Macaulay's third chapter. [15,16] It was not written as a geography, but meets the requirements that geographers ask of a work in that field. It is a principal text used in university courses on the geography of Roman Britain. It shows admirably, in substantive form, the virtues of the Idealist method. It shows also some of its defects. By considering the ideas both of individuals and of Roman society as a whole, Collingwood made the Roman occupation of Britain more intelligible than any other person has done in a book of comparable length. His analysis of Caesar's reasons for invading Britain and for landing where he did is particularly effective. The differential pattern of Roman settlement and "Romanization" in Britain is explained the more fully by being considered in terms of the aims and ideas of Roman society in relation to the British environment. Considerable attention is given to the physical environment, but it is treated always as a particular and not as a general determinant.

Stanislawski, in a short paper on an aspect of 16th century Mexico, pays similar attention to the ideas of political protagonists and the effect those ideas had upon spatial dispositions.[17] The physical environment is treated as a particular, and the inter-action of ideas and environment makes a cohesive whole.

Brown used an approximation to the Idealist method on a rather different plane. It is clear that he believed that a consideration of the ideas of a society was essential

to a reconstruction of its geography. Witness the opening paragraphs of his book on the historical geography of the United States.[18] The first sentence of the text reads : "It is related that the general use in America of the cast-iron plow was somewhat delayed beyond the year of its invention by prevailing beliefs of the time." The first line of the second paragraph starts : "Men at all times have been influenced quite as much by beliefs as by facts . . .". In another book he made a more striking attempt to deal with the geography of a period through the medium of its ideas.[19] That work may not be a complete account of the geography of the Eastern Seaboard at a certain date, but a complete account could not be given without work similar to that done by Brown being performed. In writing of the geography of that time and place only as it appeared in terms of contemporary knowledge and ideas, Brown was to a large extent re-thinking the thoughts of the past.

Neither Brown nor Stanislawski, in the works cited, has concerned himself with the prehistoric period, but there are many geographers — Sauer for example — who consider that the prehistoric period falls within the field of historical geography. Collingwood was closely concerned with that period. The concern of the classical Idealists with prehistory constitutes a curious anachronism. Most historians would not consider prehistory to be a part of their province. The Positivists would accept this limitation, even though, in terms of Positivist methodology, there is no real discrepancy between the prehistoric and the historic period. There is such a discrepancy in terms of Idealist methodology. Yet Collingwood did a considerable amount of work on pre-Roman Britain,[20] and one of the statements of Croce most often quoted is his exhortive reference to the Ligurian Neolithic.[21] Even Walsh, a subscriber to a modified form of Idealism, cites the methods of the archaeologist as an example of historic method as opposed to the methods of natural science.[22] The least successful part of Collingwood's work, however, was that in which he was concerned with the strictly prehistoric period.[23] The reasons for the discrepancy between the prehistoric and historic periods in terms of Idealist methodology can be discerned, somewhat paradoxically, in Croce's "Ligurian" statement.

Croce wrote "Do you wish to understand the true history of a neolithic Ligurian or Sicilian ? Try, if you can, to become a neolithic Ligurian or Sicilian in your mind. If you cannot do that, or do not care to, content yourself with describing and arranging in series the skulls, implements, and drawings which have been found belonging to these neolithic peoples. Do you wish to understand the true history of a blade of grass ? Try to become a blade of grass ; and, if you cannot do it, satisfy yourself with analysing its parts, and even arranging them in a sort of ideal or fanciful history." Collingwood himself did not accept the second part of this abduration, writing "Is its (a blade of grass) articulation and growth an expression of its own spiritual life ? I am not so sure. And when we come to a crystal, or a stalactite, my scepticism reaches the point of rebellion."[24] He was disposed to accept the first part of the statement. It was because he attempted to apply Idealist methodology to the study of prehistory that his studies of the prehistoric period are the least successful part of Collingwood's work. That application may be a desirable aim, but in the present state of methodology at least, it is not practicable.

The impracticability derives from the nature of archaeological evidence. In order to re-think the thoughts of the past it is necessary that there be available some expression of the abstract and refined character of those thoughts. Documentary, written evidence provides such expression : archaeological evidence rarely does so. In general, archaeological evidence does no more than indicate that a society met its basic needs of food, clothing, shelter and the like by various subsistence techniques ie., by particular kinds of hunting, agriculture, etc. The needs are common to all societies : the archaeological evidence is generally too coarse to admit of more than speculative distinctions in the ideas that were implemented by the artefacts.

There is a further, and strictly methodological, objection to the application of

Idealist method to the prehistoric period. The societies studied by the historian are self-identified. The societies of the prehistoric period are necessarily identified by the imposition of the archaeologist's typological classification. Typological classifications are positivistic rather than idealistic in their basis. Consequently there often appears either a hiatus or a discrepancy between the societies identified in the prehistoric period and those identified in the historic period.

Collingwood's principal substantive work was in the study of Roman Britain. For that period proper there is sufficient written evidence to allow of historic, and Idealist, method dominating the study. Collingwood's work on that period was outstandingly successful, in contrast to his work on the immediately preceding and succeeding periods. For Iron Age and Arthurian Britain there is, in the one case, an almost complete lack of written evidence, and in the other a most severe shortage. His work on the Iron Age has been strongly criticized. That on the Arthurian period, whilst most entertaining, is dubious.

In view of the nature of archaeological evidence that is at present available, the prehistoric period has to be studied by the methods of natural science. Although *Homo sapiens* has existed as a distinct species for at least forty thousand and probably a hundred thousand years, all men of the prehistoric period have to be studied as if they were of a species different from our own. Their thoughts cannot be rethought. In the light of this consideration, Croce's views on how to study a blade of grass do induce a "scepticism (that) reaches the point of rebellion".

Without even considering epistemological matters, there are thus certain practical objections to the exercise of Idealist method. There may also be objections on technical grounds. Renier's comment on Croce's method is an objection of this type — "Is not Croce advising the historian to go into a trance... ?"[25] But this statement can itself become a criticism of the avowedly pragmatic attitude of the critic. There is a great deal of worth in the Idealist view in both a corrective and a constructive sense. The parent philosophies may be opposed, but Positivist and Idealist methodologies are not so much irreconcilable as complementary. In practice, historians give a great deal of attention to the ideas of a society. The ideas of a society are as necessary to a study of its geography as they are to a study of its history.

REFERENCES

1. See, for example :
   GARDINER, P.: *The Nature of Historical Explanation*, University Press, Oxford, 1952.
   POPPER, K.: *The Poverty of Historicism*, Routledge & Kegan Paul Ltd., London, 1957.
   WALSH, W.H.: *An Introduction to Philosophy of History*, Hutchinson's University Library, London, 1958.
   RENIER, G.J.: *History, Its Purpose and Method*, Allen & Unwin, London, 1950.
2. DILTHEY, W.: *Einleitung in die Geisteswissenschaften*, Leipzig, 1883.
3. CROCE, B.: *Teoria e Storia della Storiografia*, Bari, 1917 (English translation: *Theory and History of Historiography*, George G. Harrap and Co. Ltd., London, 1921).
4. COLLINGWOOD, R.G.: *The Idea of History*, Galaxy Book edition, New York, 1956.
5. OAKSHOTT, M.: *Experience and its Modes*, University Press, Cambridge, 1933.
6. See BAGBY, P.: *Culture and History*, Longmans, Green & Co., London, 1958.
7. GARDINER, P.: *op. cit.*
8. POPPER, K.: *op. cit.*
9. HUNTINGTON, E.: see especially: *Mainsprings of Civilization*, John Wiley and Sons Inc., New York, 1945.
10. RENIER, G.J.: *op. cit.*
11. A discussion of this point, in a rather different context, followed the presentation of a paper by O.H.K. Spate: see SPATE, O.H.K.: Toynbee and Huntington — A study in Determinism; *Geog. J.*, 118, 1952, pp. 406-428.
12. RUSSELL, B.: *Mathematics and the Metaphysicians, in Mysticism and Logic*, Penguin Books, London, 1953, pp. 88-89.
    See also, concerning the same point: KROEBER, A.L.: History and Science in Anthropology, in *The Nature of Culture*, Chicago, 1952, pp. 63-65.
13. OAKESHOTT, M.: *op. cit.*, page 143.
14. *ibid.*, page 144.
15. COLLINGWOOD, R.G. and J.N.L. MYRES, *Roman Britain and the English Settlements*, University Press, Oxford, 1937.
16. MACAULAY, T.B.: *History of England*, edited by C.H. Firth, Macmillan and Co. Limited, London, 1913-15.

17. STANISLAWSKI, D.: The Political Rivalry of Patzcuaro and Morelia, an item in the Sixteenth-century geography of Mexico; *Ann. Assoc. Amer. Geog.*, XXXVII, 1947, pp. 134-144.
18. BROWN, R.H.: *Historical Geography of the United States*, Harcourt Brace and Co., New York, 1948.
19. BROWN, R.H.: *Mirror for Americans*, American Geographical Society, New York, 1943.
20. See obituary by RICHMOND, I.A.: *Proc. Brit. Acad.* XXIX, 1943, pp. 463-468.
21. CROCE, B.: *op. cit.*, pp. 134-135.
22. WALSH, W.H.: *op. cit.*, pp. 56-57.
23. See RICHMOND, I.A.: *op. cit.*
24. COLLINGWOOD, R.G.: *op. cit.*, p. 200.
25. RENIER, G.J.: *op. cit.*, p. 41.

CANADA AND THE INTERNATIONAL GEOGRAPHICAL UNION

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RÉSUMÉ. *Les débuts de la coopération internationale dans le domaine de la recherche géographique remontent aux premiers temps de la Confédération. Bien que la participation de canadiens aux premières réunions de Congrès International de Géographie ait été assez rare, un certain nombre d'entre eux y assistèrent a plus d'une occasion. Ce n'est que depuis 1934, année de l'acceptation officielle du Canada au sein de l'Union Géographique International, que notre pays assiste à toutes les assemblées générales de cette organisation et aux congrès géographiques internationaux. Depuis la nomination, en 1952, des premiers canadiens aux commissions de ce groupement, la participation du Canada a été intensifiée de beaucoup.*

When the Eighteenth International Geographical Congress was officially opened by His Excellency Dr. Juscelino Kubitschek de Oliveira, President of the Republic of Brazil, on the 9th August, 1956, the audience included the largest official delegation of geographers that Canada had ever sent to such a gathering — a marked contrast to the two official Canadian representatives to the Fourteenth Congress in Warsaw in 1934.

ANTECEDENTS

The first international congress came about as a result of the proposals to erect statues of Abraham Ortelius and Gerhard Mercator in their native cities in Belgium. Since these two events were planned to take place about the same time, it occurred to M. Charles Ruelens, Keeper of the Royal Library at Brussels, that this would be a suitable occasion on which to convene a gathering of the geographers of the world. In actual fact, a statue of Ortelius was not erected; the statue of Mercator was unveiled in May 1871 and the congrèss did not convene until August of that year in Antwerp.[1] After that, international geographical congresses were held roughly at intervals of four years, apart from the periods of the two World Wars.

If Canada had any connection with the Antwerp Congress and the one which followed it four years later, in Paris, it was slight. But the third congress, held in Venice in 1881, was attended by none other than Stanford Fleming, then Chancellor of Queen's University, who was the delegate of the Canadian Institute. Indeed, he made several resolutions concerning the unification of initial meridians of reference and the selection of a common zero meridian for the world, which were adopted.[2] The fourth congress, held in Paris in 1889 was attended by Urzèle Archambault, directeur de l'Academie Commercial de Montréal,[3] but the Berne Congress of 1891 passed by without any apparent interest on Canada's part. The sixth congress, held in London in 1895, included three Canadian participants. The trio was headed by Sir Charles Tupper, then Canadian High Commissioner to the United Kingdom. Sir Charles was also one of the Honorary Vice-Presidents of the Congress. The other Canadian participants were Hon. G. W. Allan of Toronto and Dr. Henry M. Ami of Ottawa. The Congress exhibition included eight samples of Canadian topographic maps and 13 samples of Canadian geological maps.[4]

Canada passed over the next Congress, held in Berlin in 1899, but when the eighth congress was held in Washington in 1904, Canada seemed to suddenly sprout geographers for six Canadians participated and eight others registered, although they did not attend. The Canadian contingent included four "officials" — James White, the Chief Geographer of the Department of the Interior; Dr. Robert Bell, who represented the Canadian Board on Geographical Names; A. O. Wheeler of the Topographical Survey of Canada and R. F. Stupart, Director of the Meteorological Service of Canada. McGill University and the University of Toronto were also represented and, for the first time, Canadians presented papers — six in all.[5]

The Geneva Congress (1908) was attended by a Captain Claude Russell-

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Brown, professor at the Royal Military College of Canada, but there is no record that he actively participated.[6]

In 1913, the tenth International Geographical Congress was held in Rome. It is of special interest to Canadians in that Vilhjalmur Stefansson was present and presented a paper on "The Canadian Arctic Expedition of 1913" as well as a verbal communication on "The Eskimo of Coronation Gulf and Victoria Island". Peary, who had attained the North Pole years before also attended.[7] But the Rome Congress was also important because during its proceedings the proposal was made for the formation of a world union of geographical societies. This was not implemented because of the outbreak of the World War I, but because of the proposal, the Rome Congress is also considered as the First General Assembly of the International Geographical Union, although the Union as now constituted arose out of the establishment of the International Council of Scientific Unions in 1919.

The Second General Assembly and the Eleventh Congress were held in Cairo. They were attended by Professor Frank Dawson Adams of McGill University, Professor C.A. Short, Professor of Astrophysics at the University of Toronto and Professor W. Pakenham, also of the University of Toronto.[8] But Canada's connection with the Union was greatly strengthened at the time of the Third General Assembly and Twelfth Congress, in 1928, when the Surveys Branch of the then Department of the Interior was asked to provide material for the map exhibit being arranged in connection with the meetings at Cambridge, England. It is of interest to note that Canada's contribution ultimately included the Regina sheet of the international map of the world — the first map in this series ever produced for any part of Canada. The records of this Congress also show that it was attended by five Canadians.[9] As Canada was not a member of the Union, they were not official delegates or representatives of particular institutions or organizations but Professor H.A. Innis presented a paper[10] and Major G.G. Aitken took part in the discussions.[11] Professor Innis was later to become Chairman of the Department of Political Economy at the University of Toronto and still later Dean of Graduate Studies there, while Major Aitken was Chief Geographer for the Province of British Columbia. The next Congress, in Paris in 1931, went by without Canadian participation despite the fact that invitations were despatched by the famous geographer Emmanuel D. Martonne.

CANADA AS A UNION MEMBER

By 1934, however, there was a revival of interest on Canada's part. The Statutes of the International Geographical Union state that "a country may join . . . either through its principal Academy, or through its National Research Council, or through some other similar institutions, or through scientific societies, or an association of such institutions or societies"[12] and in August 1934 the Canadian Secretary of State for External Affairs informed the I.G.U. Secretariat (then in Paris) that arrangements had been made "for the adherence of the Government of Canada to the International Geographical Union through the Canadian Geographical Society" — there being no organization of professional geographers at that time. Thus, the Fifth General Assembly and Fourteenth Congress held in Warsaw that year was attended by two "official delegates". These were Lt.-Col. Grant-Suttie and Dr. Lawrence Burpee[13] who was then the editor of the *Canadian Geographical Journal*, which had commenced publication in 1930. Three volumes of the *Canadian Geographical Journal* were on display, together with the 1929 edition of Burpee's *Discovery of Canada* and eighteen sheets of maps. In addition, the Topographical Survey of Canada printed leaflets for distribution at the Congress which outlined the progress made in federal mapping for the period 1931-34.

The I.G.U. Statutes state that "A National Committee shall be formed in each of the countries belonging to the Union"[14] on the initiation of the sponsoring national organization and in February 1936 the Canadian Geographical Society authorized Lt.-Col. Grant-Suttie to organize a National

Committee for Canada. By October this had been done. The Committee consisted of a Chairman, appointed by the Prime Minister of Canada, four others appointed by the Government of Canada, four representatives from the Province of Quebec and eight members at large.[15] Lt.-Col. Grant-Suttie himself was appointed Chairman. The original sixteen members included only two professional geographers — Professor B. Brouillette (Université de Montréal) and Professor Griffith Taylor (University of Toronto). The remainder were well known civil servants, teachers and professors in surveying and mapping, economics, history, agriculture and geology. Part of the Committee met in 1937 and suggested that a new Atlas of Canada should be produced. It was to be twenty-one years before the results of this suggestion were available to the public! Nineteen thirty-seven was also a significant year in that the Committee met in Ottawa at the same time as the other Learned Societies. This foreshadowed the procedure used by the Canadian Association of Geographers after its formation in 1951.

The 1938 International Geographical Congress was held in Amsterdam. A lone Canadian, Prof. B. Brouillette, attended and presented a paper.[16] It was in this year that the Canadian Social Science Research Council was formed and one of the four sponsoring bodies was the Canadian Committee of the International Geographical Union.

Then came World War II and the first post-war International Geographical Congress was held in Lisbon, in 1949. By this time professional geography had advanced considerably in Canada. The Geographical Bureau (later Branch) had been established within the Federal Government and several Canadian universities had established departments of geography. No less than ten Canadians attended the Lisbon Conference,[17] four of whom formed the official delegation and three of whom presented papers.[18] The Federal Government provided a book and map exhibit which included the notable map of the geographical regions of Canada, later made into a filmstrip by the National Film Board and adopted by at least one province (Ontario) as the basis for its geographical curriculum in high schools. At this Congress, one member of the Canadian delegation, Professor G. Kimble of McGill University, was elected Secretary-Treasurer of the Union — the first time that Canada had ever been represented on the International Executive although whether this was to Canada's credit or not is debatable as Professor Kimble did not come to Canada until 1945 and he left it in 1950.

The Seventeenth Congress in Washington in 1952, because of its proximity to Canada, was attended by even more Canadians — no less than thirty-six, of whom four constituted the official delegation[19] and five represented various universities and Canadian institutions. Eight presented papers.[20] Among the maps on display were manuscript samples of land use mapping which the Geographical Branch had begun in eastern Canada.

For the first time a Canadian was appointed as Chairman of one of the Commissions of the I.G.U., when N. V. Scarfe, then Dean of Education at the University of Manitoba was appointed to that post on the Commission of the Teaching of Geography in Schools. Professor B. Brouillette was appointed a corresponding member of the same Commission. In addition, Professor F.K. Hare was appointed a member of the Commission on Medical Geography and Dr. J.W. Watson a corresponding member of the Commission on Inventory of World Land Use. During the four years which followed, Canadian geographers also assisted other commissions in their work.[21]

REORGANIZATION OF THE CANADIAN COMMITTEE

The Canadian Committee had functioned almost as a professional society of geographers for many years largely through the efforts of Lt.-Col. Grant-Suttie who had almost single-handed kept the spirit and purpose of professional geography alive since the 1930's and personally paid Canada's fees to the Union (although they were forwarded through official channels). His death in May 1949, therefore, marked the end of an era. But more than that, by 1949 an awareness of the value of

professional geography had spread and, with the establishment of the Geographical Branch within the Federal Government, Canada's fees to the International Geographical Union were paid from public funds. In 1949 the Rev. Dr. Canon H.J. Cody, some time President and later Chancellor of the University of Toronto, was appointed Chairman of the Canadian Committee and upon his death in 1951, Dr. H. A. Innis succeeded to the position. When he died in 1952, it was considered that the time had come to reorganize the Canadian Committee completely. In 1950 the Canadian Association of Geographers had been formed and it was then regarded as being the most suitable organization to sponsor the Canadian Committee. It was considered that the Committee should consist of professional geographers, as they were now in sufficient numbers in Canada, and a new constitution along these lines was formulated when the Canadian Association of Geographers met at the Learned Societies' Conference in London, Ontario, in 1953. Dr. B. Brouillette was appointed Chairman by the Government of Canada.

The Eighteenth International Geographical Congress held in Rio de Janeiro was unique in the annals of the International Geographical Union as it was the first time that it had met in the Southern Hemisphere and the first time in Latin-America. Canada, as a nation in the Americas, had, therefore, special interest in the meetings and sent an official delegation of ten persons, including two from the Federal Government. As in Lisbon and Washington, its map exhibit was notable and it unveiled to the public preliminary sheets of the *Atlas of Canada* and the *Atlas of British Columbia*. Six Canadians presented papers[22] and, following this Congress, Canadians were appointed to several of the Commissions of the Union. Dr. B. Brouillette was made Chairman of the Commission on the Teaching of Geography in Schools and Dean Scarfe, by this time at the University of British Columbia, was appointed a member of the same Commission. Professor Hills of McGill University was appointed a member of the Commission on the Humid Tropics and also serves as Secretary of that Commission. Dr. L. Hamelin of Université Laval was appointed a member of the Commission on Periglacial Morphology; Dr. N.L. Nicholson a corresponding member of the Commission on National Atlases; and Dr. B. Robitaille a corresponding member of the Commission on Applied Geomorphology. In 1957, a regional meeting of the I.G.U. was held at Tokyo and Nara, Japan, to which Dr. N.L. Nicholson was appointed Canadian delegate.[23] He presented a paper and was Chairman of one of the Sessions on Land Use.[24]

CONCLUSION

The development of international cooperation in geographical research on an organized basis is almost as old as the Confederation of Canada itself. Several of the early International Geographical Congresses were not patronized by any Canadians, but some were so attended and by notable people. But since 1934, when Canada formally joined the International Geagraphical Union, at least one Canadian has been present at every General Assembly of the Union and at every International Geographical Congress. Since 1952, when the first Canadians were appointed to Commissions of the Union, Canadian participation has intensified and thus, as its geographical fraternity and its experience grows, Canada is better able to cooperate in international research for the betterment of mankind.

REFERENCES

1. CLOSE, Col. Sir Charles: Address at the Anniversary General Meeting of the Royal Geographical Society; *Geog. J.*, LXXII, 1928, pp. 100-101.
2. WHEELER, George M.: *Report upon the Third International Geographical Congress and Exhibition at Venice, Italy*, 1881, Washington, 1885.
3. *Comptes-rendus du IV^e Congrès International des Sciences Géographiques*, 1889, Paris, 1890.
4. *Report of the Sixth International Geographical Congress*, 1895, John Murray, London, 1896.
5. PROWSE, G.R.F.: The Cabot Landfall; WHITE, James: Economic Geography of Canada; COLEMAN, A.P.: Glacial Lakes and Pleistocene changes in the St. Lawrence valley; STUPART, R.F.: The Canadian Climate; WHEELER, A.O.: Photographic

methods employed by the Canadian Topographical Survey; WILSON, A.W.G.; Physiography of the Archean Areas of Canada; *Report of the Eight International Geographic Congress*, 1904, Govt. Printing Office, Washington, 1905.

6. De Claparède, Arthur, *Compte Rendu des Travaux du Neuvième Congrès International de Géographie*, Société générale d'Imprimerie, Geneva, 1909.
7. *Atti del X Congresso Internazionale di Geografia, Roma*, 1913, Rome, 1915.
8. *Comptes-rendus du Congrès International de Géographie*, Le Caire, 1925. The wives of these three participants also registered.
9. Major G.G. Aitken, M.C.: Dr. H.M. Ami; W.K. Gibb; Dr. H.A. Innis; T.F. McIlwraith.
10. INNIS, H.A.: Industrialism and settlement in Western Canada; *Report of the Proceedings of the International Geographical Congres, Cambridge* 1928, Cambridge, University Press, 1930, pp. 369-376.
11. *ibid*, pp. 131 and 317.
12. *The I.G.U. Newsletter*, VII, 1956, p. 41.
13. Mrs. Grant-Suttie and E.R. Gavin also registered.
14. *The I.G.U. Newsletter*, VII, 1956, p. 41.
15. GRANT-SUTTIE, Lt.-Col. G.L.P.: New Atlas of Canada; *Industrial Canada*, XLVII, 1947.
16. BROUILLETTE, Benoit: Le développement industriel du port de Montréal; *Comptes-rendus du Congrès International de Géographie, Amsterdam*, 1938, Tome II, Sect. IIIb, Leiden, E.J. Brill, 1938, pp. 8-36.
17. Dr. F.J. Alcock, Ivor Bowen, Dr. B. Brouillette and Dr. G. Kimble formed the official delegation. Others attending were Père J.-G. Aumont, Lt.-Col. Grant-Suttie, Dr. T. Lloyd, J.L. Rannie, Mrs. Rannie and Dr. B. Zaborski.
18. ALCOCK, F.J.: Cartography in Canada since 1938; BROUILLETTE, B.: Les sources de l'étude du peuplement au Canada; AUMONT, J.-G.: La géographie dans l'enseignement secondaire au Canada français; *Comptes-rendus du Congrès International de Géographie, Lisbonne*, 1949, Tome IV, (pp. 375-387). Tome I (pp. 203-204), Tome III (pp. 411-420) and Tome IV (pp. 375-387).
19. Prof. D.F. Putnam, Prof. B. Brouillette, Dr. J.W. Watson, Mr. A. Larocque.
20. DRUMMOND, R.N., Ian McKAY and F. K. HARE: Investigation in the Boreal Forest of Labrador-Ungava, 1948-1951; MEEN, V. Ben: The Origin of Chubb Crater; ROBINSON, J. Lewis: The Northern Extension of the Pioneer Fringe of Agriculture on the Great Plains of Canada; SCARFE, N.V.: Recent Research on the Teaching of Geography; WATSON, J. Wreford: Land Use Surveys in Canada; ZABORSKI, Bogdan: Geographical Aspects of Migrations of Ethnic Groups in Northern Eurasia; *Proceedings — Eight General Assembly and Seventeenth International Geographical Congress*, International Geographical Union, Washington, National Academy of Sciences — National Research Council, 1957. ROUSSEAU, Jacques: Les Zones Biologiques de la Peninsule Québec-Labrador et l'Hemiarctique; *Can. Jour. Botany*, 30, 436-474.
21. Messrs. Hare, Bird and Brochu (see *Premier Rapport de la Commission pour l'étude . . . des niveaux d'érosion . . . autour de l'Atlantique*, New York, 1956, p. 12); N.L. Nicholson (see *First Report of the Commission on the Arid Zone*, New York, 1956, p. 1); M. Brochu (see *Commission de Morphologie Périglaciaire Rapport*, New York, 1956, pp. 9-14).
22. BROUILLETTE, B.: Les conséquences de la canalisation du Saint-Laurent sur les exportations canadiennes de céréales; GARRY, Robert J.: Les transports aériens au Canada; NICHOLSON, N.L.: The evolution of the political map of Canada; ROBINSON, J. Lewis: Geographical Regions of Canada; WEIR, T.R.: Land use and daytime population in metropolitan Winnipeg; ZABORSKI, Bogdan: Types of Rural Settlements of Canada and their geographical distribution; *Abstracts of Papers, Eighteenth International Geographical Congress*, Rio de Janeiro, 1956.
23. NICHOLSON, N.L.: International Geographical Union Regional Conference in Japan; *Can. Geo., J.*, LVI, 1958, pp. 36-37.
24. NICHOLSON, N.L.: Land Use Mapping in Canada; *Proceedings of IGU Regional Conference in Japan* 1957, Tokyo, 1959, pp. 564-570.

SHORTER COMMUNICATIONS — BRÈVES COMMUNICATIONS

CANADIAN ASSOCIATION OF GEOGRAPHERS NINTH ANNUAL MEETING

The great success of the 9th Annual Meeting, held at the University of Saskatchewan from May 27th to May 29th, rests largely with the members of the Association who are officers of the Saskatchewan Department of Natural Resources. Their job was made all the more difficult as this year, for the first time, the CAG met at a university which had no department of geography.

There were four highlights to this meeting. The first was an all-day trip to the site of the South Saskatchewan Dam. The second was the Presidential address by Professor J. Brian Bird. The third was an address by The Honorable T. C. Douglas, Premier of Saskatchewan, which followed the association's banquet. The fourth, and an innovation for the CAG, was a weekend field trip for some of the members to Little Bear Lake in central Saskatchewan, as guests of the Provincial Department of Natural Resources.

At the Annual General Meeting the election of the following new executive was announced: President — D. P. Kerr; Vice President — E. G. Pleva; Councillors — A. Davidson and G. C. Merrill; Secretary — B. Cornwall; Treasurer — N. C. Field; Assistant Secretary Treasurer — D. St. Onge.

L'ASSOCIATION CANADIENNE DES GÉOGRAPHES NEUVIÈME ASSEMBLÉE ANNUELLE

Le grand succès obtenu lors du 9e Congrès Annuel, tenu à l'Université de la Saskatchewan, 27-29 mai, revient avant tout aux membres de l'Association attachés au ministère des Ressources Naturelles de la Saskatchewan. Leur travail avait été rendu d'autant plus difficile cette année du fait que pour la première fois, l'A.C.G. tenait ses séances à une université qui n'est pas dotée d'institut de géographie.

Quatre faits saillants dominèrent le congrès. Le premier fut une excursion sur le terrain d'une journée entière au site du barrage en construction sur la rivière Sud Saskatchewan. Le deuxième consista dans le discours d'adieu du président sortant par le professeur J. Brian Bird. Le troisième fut un discours de l'Honorable T. C. Douglas, premier ministre de la Saskatchewan, qui clôtura le banquet de l'association. Le quatrième, qui constituait un précédent pour l'A.C.G., consista en une excursion de fin de semaine de deux jours sur le terrain pour plusieurs des membres, au lac Little Bear en Saskatchewan centrale, où ils furent les invités du Ministère provincial des Ressources naturelles.

Au cours du Congrès général annuel les résultats de l'élection pour le choix du nouvel exécutif furent rendus publics et se lisent comme suit :

Président, D. P. Kerr; Vice-Président, E. G. Pleva; Conseillers, A. Davidson et G. C. Merrill; Secrétaire, B. Cornwall; Trésorier, N. C. Field; Assistant Secrétaire-Trésorier, D. St-Onge.

B. Cornwall

GLACIER ICE-THRUST FEATURES OF THE YUKON COAST*

Deformation of Pleistocene or earlier sediments is present along most of the Yukon Coast between King Point on the east and Herschel Island on the west. Tilted, folded, and contorted sediments with truncated beds, thrust faults, closely spaced shear planes, and clastic dikes are exposed along many miles of coastal bluffs. Inland from the coast, arcuate to irregular ridges, cuestas, linear streams, and lake shapes give additional evidence for deformation. These disturbances are believed to have been caused by glacier ice-thrust.

Although much remains to be discovered about the mechanism of ice-thrusting, the theory seems to explain the type of disturbed sediments of the Yukon Coast. It accounts for : a confining pressure for the deformation of gravels, sands, silts, and clays; the remarkable agreement of deformed sediments with the extent of the glaciated area; the shapes, orientations, and dips of the disturbed beds at Herschel Island, Kay Point, and King Point; the topographic anomalies of Herschel Island, Kay Point, and King Point; and the presence, specific location, orientation, and size of Herschel Basin. The disturbances may have occurred during the closing stages of glaciation, but not necessarily in late Wisconsin. Perhaps high neutral stresses in pore water, coupled with disturbances resulting from the melting of ground ice in the basal part of a permafrost zone, might have helped to reduce the shearing strength of the sediments.

J. Ross Mackay

SOME COMMENTS ON LAND DIVISIONS AND SETTLEMENT PATTERNS IN THE CANADIAN WEST*

It is no overemphasis to say that most geographers who have written about the Canadian West have regarded the sectional survey as essentially part of, one might say, the "received" environment. Perhaps they are not far from the truth, because the sectional survey not only covers practically the entire prairie region, but also preceded settlement over most of this area. But other land divisions were introduced prior to the sectional survey, and there were some departures from it after its inception. They include the survey of the Selkirk Colony, the Métis river lots, the Mennonite open-field system, and more

* Abstract of a paper presented at the Ninth Annual Meeting of the Canadian Association of Geographers, Saskatoon, 1959.

recent adaptations of the sectional survey. These surveys, together with the sectional survey, merit investigation because the land division plays a very important role in the social and economic development of an agricultural area : a survey may encourage dispersed or nucleated settlement, and it may or may not prove a suitable land division for settling a region. The nature of the economy, the type of farming, tradition, and the stage of agricultural technology are all important factors in determining the extent to which settlers conform to a prescribed survey; whether there are any efforts to have the prevailing land division modified. The following generalizations about the land division in the Canadian West can be made: the sectional survey has definitely proved to be suitable for the Canadian grain growing economy; the earliest departures from it were usually made by people with strong traditions of other land divisions, some derived from within North America, others from Europe; and that new planned land developments, improved transportation facilities, and changes in the nature of farming are bringing about still further adjustments within the sectional survey in specific areas.

J. H. WARKENTIN

FUNCTIONAL RANKS AND LOCATIONAL PATTERNS OF SERVICE CENTRES IN SASKATCHEWAN*

The analysis of urban centres, their functioning, and locations has often been undertaken by economists and geographers. Although the basis of urban centres' existence is economic, it is the space element which attracts the attention of the geographer.

Urban centers provide central services for the surrounding farm population which cannot be supplied by individual households. While commercial services are more dominant in the urban communities, the other services such as administrative, cultural, and public hold a significant rank. Depending on the proximity to these services one can distinguish the degree of their importance. Services which are widely scattered are less central than services concentrated in few localities only.

The provision of the services is largely affected by two factors : fixed cost of the establishment, and the frequency of the demand for the given service. For example, a service which does not require considerable capital outlay for buildings and stock, and which is continously in demand such as general store or garage can easily thrive in a small radius area. On the other side, such services as a furniture store or automotive dealer which are characterized by less frequent demand and higher investment can only survive when serving an adequately large area.

Analyzing the frequency distribution of various kinds of central services and the radius of their tributary area, one can distinguish six functional grouping for all service centres in Saskatchewan. Referring to the administrative status of the communities where applicable, they can be identified as follows : H centre (hamlet), V centre (village), T centre (town), GT centre (greater town), SC centre (small city), MC centre (medium city).

In analyzing the locational patterns of service centres, one can design a theoretical model of service centre distribution following the principle of the most rational utilization of the available facilities. Such an approach was devised by the German economist and geographer, W. Christaller, in 1933. Based on certain assumptions in regard to the farm population density, soil conditions, etc., and containing conclusions in regard to the spacing of various ranks of centres, such a model serves as a yardstick for appraising the actual conditions. Compared with thtis pattern of centre distribution, which can be called accommodation principle, the transportation factor is strong enough to distort the location of centres to the extent that it can be considered as an independent factor.

P. WOROBY

SOME PROBLEMS IN PLANNING FOR OUTDOOR RECREATION IN SASKATCHEWAN*

Outdoor recreation in Saskatchewan as a form of land use is of recent origin in the province and has only begun to make itself felt since about 1950. As is the case generally in Northern America, it appears to be a concomitant of urbanization among other things. Although the total population of the province is only about 900,000 and in spite of the significance of agriculture in its total economy a definite trend in population movement from a rural to an urban pattern has developed.

A large percentage of the province's population is resident in the plains area which from the standpoint of providing public recreation facilities, gives rise to three major problems:

(a) the absence of major water bodies naturally endowed with game fish (angling is one of the most popular outdoor recreational activties)
(b) the absence of tree growth
(c) the awkward location of established provincial parks relative to the main loci of population in the province.

Since on the average, people in the province do not travel more than 50 miles for a picnic, for swimming, angling and so forth, serious problems have arisen with respect to over-crowding of available recreation facilities, the loss of public access, the rise in land values to as much as $6,000.00 to $10,000.00 per acre.

These and other problems bring into prominence the question of the establishment of new provincial parks along the major spillways of southern Saskatchewan including the Qu'Appelle,

* Abstract of a paper presented at the Ninth Annual Meeting of the Canadian Association of Geographers, Saskatoon, 1959.

the South Saskatchewan, and the Souris. It also focuses attention on established or proposed reservoirs like the South Saskatchewan dam, and several other smaller man-made lakes in the southern part of the province.

R. G. YOUNG

L'INFLUENCE DU RELÈVEMENT POST-GLACIAIRE SUR LE RÉSEAU HYDROGRAPHIQUE DE LA VALLÉE DU SAINT-LAURENT.*

Le relèvement post-glaciaire a conditionné le retrait de la mer Champlain et par suite la formation du fleuve de Montréal (1) issu de cette mer. L'influence de ce relèvement sur le tracé du réseau hydrographique mérite une attention toute spéciale qui peut s'appuyer sur des faits facilement observables. Voici quelques-uns de ces faits ayant trait au problème posé.

Tout d'abord, notons que la vallée du Saint-Laurent est curieusement dissymétrique. Cette dissymétrie se manifeste par un refoulement des formes résiduelles vers le bouclier laurentien. En effet, le fleuve de Montréal (résiduel) n'a pas l'allure d'un axe au milieu des Basses-Terres. Ce résidu marin est refoulé vers les Laurentides, non seulement dans l'Outaouais ou dans l'Estuaire où c'est une évidence, mais aussi entre Montréal et Québec où la distance qui le sépare des Laurentides est relativement plus courte que du côté des Appalaches et des Adirondacks. Cette tendance vers le Nord se manifeste partout dans les Basses-Terres; on devine qu'une lutte s'est engagée entre cette force attractive et les agents deltaïques ou simplement structuraux (par exemple la dépression paléozoïque du Lac Saint-Pierre). De grosses rivières, (Gatineau, Lièvre) venant du Nord n'ont pas pu éloigner l'Outaouais vers le Sud, leurs deltas ont abdiqué. Des accumulations plus importantes ont réussi quand même à éloigner le fleuve du Bouclier (entre autres la terrasse du Grand-Côteau), mais la déviation est restreinte et les talus abrupts trahissent un travail intense opéré en sens contraire. Aussi les terrasses proprement marines (150' et plus) en plus de s'échelonner toutes sur la rive Nord, présentent des talus qui regardent le sud (Grand-Côteau, Rue Sherbrooke, Sainte Mélanie, Saint-Maurice, etc.,). Il y a une foule d'autres phénomènes locaux qui, pour avoir une explication, semblent exiger une telle tendance des formes résiduelles vers le Nord. Par exemple, de deux chenaux sillonnant une plaine alluviale, le chenal Nord prédomine et l'autre se colmate. En effet, les rivières ne coulent pas au milieu de leurs alluvions mais à leur limite Nord; c'est le cas du Saint-Laurent alluvial de Boucherville et de Verchères, dans cette région, les alluvions récentes jalonnent seulement la rive Sud, d'où l'on peut conclure que les multiples chenaux se colmatent d'abord par le Sud (c'est ce qui se produit actuellement dans les Iles de Boucherville et de Verchères). La rivière Richelieu coule à l'extrémité ouest (ou vers le Nord-Ouest) de ses alluvions récentes, la Rivière des Prairies baigne l'escarpement des-Encores (Nord-Ouest); les exemples de cet ordre sont nombreux. Un autre phénomène beaucoup plus compliqué ressort de cette attirance vers le Nord. C'est l'imposition du fleuve résiduel (constitué ici par les rivières des Prairies et des Mille-Iles, et le Saint-Laurent) à travers la surélévation rocheuse qu'est l'archipel d'Hochelaga (d'où ces lacs de barrage rocheux, Saint-Louis et Deux-Montagnes). A l'endroit où la déviation deltaïque avait moins d'importance, le fleuve, qui avait le choix entre cet obstacle et un passage qui semble aujourd'hui facile par les dépressions du Sud (via le Bassin Chambly actuel), a préféré se frayer un tracé à travers la roche en place. Le coude que décrit le fleuve à Laprairie (réplique du coude du Grand-Côteau à Terrebonne) marque l'endroit où la tendance dont nous chercherons à connaitre la nature prévaut sur la déviation deltaïque. L'Ile Ste-Hélène est le site d'une épigénie déterminée par cette force attractive vers le Nord.

De quelle nature est cette tendance ? Des coupes transversales éclaircissent les grandes lignes du problème. En effet, le plancher alluvial décrit une pente décroissante vers les Laurentides.

Une première conclusion facile en découle; en vertu de cette pente, le fleuve résiduel aura tendance à séjourner le long des Laurentides (c'est la loi de la gravité) et par suite il y aura une plus grande épaisseur de sédiments, il y aura plus de terrasses, etc.

Mais le problème sera réellement clair quand on démontrera que cette dépression est d'origine ISOSTATIQUE. La pression de la glace beaucoup plus forte sur les Laurentides que sur les Appalaches et les Adirondacks, a déterminé les profondeurs marines le long du Bouclier.

L'équilibre isostatique joue un rôle prédominant dans le tracé du réseau hydrographique, il explique tous les aspects que nous venons d'observer.

GILLES RITCHOT

* Résumé d'une communication présentée à la neuvième réunion annuelle de L'Association Canadienne des Géographes, Saskatoon, 1959.

NOTED

— that Dr. N. L. Nicholson was elected Chairman of the Canadian Board on Geographical Names for 1959. This is the first time that a professional geographer has occupied this office since the Board was established, although the Geographical Branch has had a representative as a member of the Board since 1947.

— that the Blue Ribbon Award for 1959 in the Geography and Travel Category was presented by the American Film Assembly of New York to the National Film Board for their three filmstrips on the *Great Lakes — St. Lawrence Lowlands Region.*

— and that the new Atlas of Canada is the star of *Portrait of Canada*, a National Film Board colour film now showing in theatres across the country.

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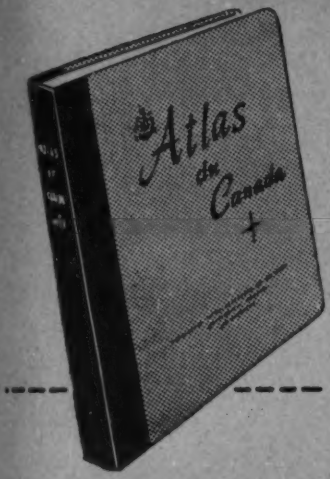

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